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THE SANITARY INSTITUTE, INCORPORATED 1888.
SALUS GENERIS HUMANI.

1890.

TRANSACTIONS

OF

THE SANITARY INSTITUTE.

VOLUME XI.

(Being Volume II. of the Transactions of The Sanitary Institute.)

CONGRESS AT BRIGHTON.

1890.

LONDON:
OFFICES OF THE SANITARY INSTITUTE, 74A, MARGARET STREET, W.
EDWARD STANFORD, 26 & 27, COCKSPUR STREET, CHARING CROSS, S.W.

1891.

EDITING COMMITTEE.

The Institute is not responsible for the facts and opinions advanced in the Addresses and Papers published in the Transactions.

Kenny & Co., Printers, 25, Camden Road, Camden Town, N.W.

TABLE OF CONTENTS.

SECTION III.

Chemistry, Meteorology, and Geology.

LECTURES DURING THE CONGRESS.

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PREFACE.

The present Volume of Transactions is the second published since the incorporation of the Institute in August, 1888, but is numbered Volume XI. in continuation of the series published by the old Society, The Sanitary Institute of Great Britain.

It is principally a record of the Congress held at Brighton, and in order to place the print of the papers read in the hands of the members as soon as possible, the Volume is issued several months earlier than usual; this, however, prevents the Annual Report for the year 1890 being included, as the Volume had to go to press before the meeting was held.

SESSIONAL MEETINGS

For the reading of papers and for discussions upon subjects connected with Sanitary Science.

Some years ago meetings of this kind were held by The Sanitary Institute of Great Britain, but latterly their place has been taken by General Lectures during the winter and spring. As, however, several members expressed a wish for an opportunity of discussions, which were scarcely appropriate after a lecture, the Council decided to hold Sessional Meetings, at which discussions could be introduced.

The following meetings were held:—

December 11th, 1889, Mr. G. J. Symons, F.R.S., in the chair.

Paper read by Mr. W. Santo Crimp, on "Sewerage Works and Sewage Treatment"; a discussion followed, in which Mr. Rhodes, Mr. Sillar, Mr. Volheim, Dr. Howell Williams, Mr. Penny, and Mr. Worth took part.

February 12th, 1890, Prof. W. H. Corfield, M.A., M.D., in the chair.

Paper was read on "Dwellings for the Labouring Classes," the paper being prepared by Mr. K. D. Young. A discussion followed, in which Mr. Robins, Mr. Collins, J. Theodore Dodd, Sir H. S. Cunningham, and other members took part.

Wednesday, March 12th, 1890, Prof. W. H. Corfield, M.A., M.D., in the chair.

Paper was read by Major Lamorock Flower, for Mr. W. Kinninmond Burton, on "The Sanitation of Japan." A discussion followed, in which Dr. Drysdale, Mr. E. J. Poggio, Mr. H. H. Collins, Mr. Y. Nakajima, and Mr. T. Nakahashi took part.

April 23rd, 1890, Sir Robert Rawlinson in the chair.

The Chairman gave an address on "Sanitary Science," dealing principally with the Sanitation of Barracks and other Public Buildings.

At this meeting the Medals and Certificates awarded at the Worcester Exhibition were presented to the successful Exhibitors.

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INAUGURAL ADDRESS,

Delivered August 25th, 1890.

By SIR THOMAS CRAWFORD, K.C.B., M.D., LL.D.

PRESIDENT OF THE CONGRESS.

The formation of a national Society having for its main object the advancement of all subjects bearing upon the public health, was a philanthropic conception which found expression in the inauguration of the Sanitary Institute of Great Britain in 1876. That society has now been amalgamated with a kindred association, founded in honour of the great apostle of practical hygiene, the late Professor Parkes. The Sanitary Institute thus constituted, has extended its sphere of usefulness, without curtailing in any way the objects for which these allied institutions were originally founded.

One of the chief objects was, and still is, the holding of meetings and exhibitions like the present, in such populous and influential centres as might be moved, in the interests of the public, to offer the Institute facilities for the purpose.

The first and most pleasing duty devolving upon me as your President, is to tender the hearty thanks of The Sanitary Institute to the Mayor and Corporation of Brighton for their hospitable invitation, and for the very liberal provision which has been made for the accommodation of every branch of the congress, including the Health Exhibition, an educational auxiliary which is, in the opinion of the council, of very great importance.

My next words must be couched in terms of regret, for the loss of one who has long held a prominent position among the officers of the Institute, of which he was an esteemed Vice-President. I need hardly say I allude to Sir Edwin Chadwick,

whose recent death leaves a blank in the roll of worthies, whom philanthropists in general, and sanitarians in particular, delight to honour. Robust of frame, resolute of purpose, quick to perceive the irresistible logic of facts, and indefatigable in collecting such as throw light on the health condition of the wage-earning classes in particular, he exercised a powerful influence for good over the social and sanitary legislation of the past half century. It was mainly through his action, that Lord Lyndhurst was induced to support and carry through Parliament, an Act authorizing the establishment of the Registrar General's office, from which has since issued masses of carefully prepared vital statistics which are invaluable. We are also largely indebted to him for those earlier Royal Commissions, which have contributed so materially to improve the sanitary condition of our public services. Sir Edwin Chadwick was spared to exceed by many years the proverbial three-score years and ten, and to the last he retained a freshness and vigour of intellect, as much above the average as was his length of days.

In opening this Congress your President naturally looks to the past for guidance in the selection of a subject on which to address you; but I regret to say the further I proceeded in my investigation the greater became my difficulty. The able and exhaustive addresses of the distinguished men who have presided over previous Congresses, and the valuable and eminently practical suggestions to be found in them, as well as in the numerous papers read at the several meetings and recorded in our Transactions, have so fully traversed the whole subject of public health, that it is not easy to find anything new and at the same time worthy of my audience. The sections on *Engineering and Architecture*, *Chemistry*, *Meteorology*, *and Geology*, may be left with great confidence to those who have been selected to preside over them. *Sanitary Science* and *Preventive Medicine*, the section in which I find myself most at home, has been wisely entrusted to Dr. George Vivian Poore, from whom it is certain to receive ample elucidation. Taking my inspiration from a theologian of our own day, who announced his intention of repeating a particular discourse till his congregation had not only mastered its contents but put its precepts into practice, I shall endeavour to lay before you some fragments of a tale that cannot be too often repeated: the story of laws violated to the prejudice of health, and as swiftly and surely avenged, even to death as a penalty.

This thought recalls a nation in mourning for a royal prince, whose premature death from a disease now well known to be altogether preventable, was the text of many heart-stirring orations from pulpit and platform at the time, and subsequently.

Of these I remember with tolerable clearness two delivered on the Sunday following the sad event, by two of the most eloquent preachers then in London. The first took for his subject man in perfect health, and in the full vigour of his physical development. To the mere physiologist, presumably ignorant of the teaching of experience, that death is the common lot of all, such a man, so fully endowed with every means and appliance necessary for the repair or removal of wasted or damaged tissues, needed only the requisite sustenance to live indefinitely. Assuming that this physiological view was well founded, the preacher went on to ask, "Why does man die?" Then, turning away from physiology, he pictured to his audience the scene in the Garden of Eden, with its tragic ending in Adam's transgression, and so death fell upon all men.

In the afternoon the second pulpit orator took for his starting point a picture of nature in her loveliest aspect and most perfect development, and, beginning with the germ, quickened into activity by the genial glow of early spring, he described the development of the budding plant, the opening leaf, the full-blown flower, the ripening fruit, and, finally, the withering influences of autumn, and the eventual decay and ultimate death of the organism. Extending his illustration to all nature, he pointed out that, within fixed limits as to time, all must die. No exceptions. Plants, animals, man himself, the latest and most perfect work of God, all must bite the dust. And, having pronounced the sure doom of all, the preacher proceeded to draw his moral—"Be ye ready."

Without questioning either of these views, or the lessons drawn from them by their respective exponents, the scientist, who has given careful attention to biology as a science, is justified in asking whether they meet adequately the needs of man as a whole, morally and physically degraded as in too many instances he is by the vicious influences of unwholesome surroundings. The clergy of all denominations are indefatigable in their endeavours to save men's souls, and, with that object in view, they are zealous at all times in enforcing the due observance of the moral law; but it has often occurred to me that all this important work would be materially advanced if coupled in a larger measure with equally zealous efforts for the enforcement of those physical laws, the violations of which are, in many instances, the direct cause of the needless and wasteful suffering and misery, premature decay, and early death entailed by preventable disease.

The clergy as a body do undoubtedly take an active interest in the physical as well as the spiritual condition of the people, but if one may judge from the polluted atmosphere which too

often pervades the places set apart for religious assemblies, they are not sufficiently equipped with that sanitary knowledge which is so essential for those who undertake to guide the people in such matters. It is for this reason we hail with special satisfaction such sermons as that delivered by the Dean of York, on the occasion of our visit to that city in 1886; and still later by Canon Creighton, before the Congress at Worcester, in 1889. I cannot pass on without quoting two sentences from the admirable address of the latter: "It is hard," says the Canon, "for those who live with enfeebled frames, amid neglected and filthy surroundings, to feel strong aspirations after the beauty, the purity, and the truth of a spiritual life." "The conditions under which life is lived—the unwholesome air of the factory, the crowded room, the ill-ventilated chamber, all these rob the body of its vigour, how must they react on the soul? You heard in the epistle this morning of the works of the flesh—uncleanness, hatred, variance, drunkenness, revellings; do not these things, think you, come very largely from, and are they not very largely affected by, the physical conditions with which life is lived?" But read for yourselves; the Sermon is published in extenso in Vol. X. of the Transactions of The Sanitary Institute just issued. These Sermons and the kindred Address recently delivered by His Grace the Archbishop of Canterbury before the British Medical Association at Birmingham, make us hope that in the near future the clergy will rival the medical profession in their pursuit of that knowledge, by means of which the suffering and misery entailed upon the people by preventable disease can alone be effectually met; and that, with this end in view, they will enroll themselves in large numbers as members of The Sanitary Institute.

The laws which govern the origin and spread of preventable disease are not merely physical, as some scientists are apt to assume, nor are they merely moral laws, the violation of which entails those terrible consequences to which Canon Creighton alludes. They are both. There is a moral as well as a physical code which must be observed if men are to realize all that may reasonably be hoped for in preventive medicine.

Take for example those more common forms of contagious diseases which are spread mainly by human intercourse, and test how far individuals observe those precautions which are known to be sufficient to protect others, and you will find the results most unsatisfactory. Any lady who is accustomed to district visiting among the poor, will be able to recount instances of mothers of families visiting such cases out of mere idle curiosity, a blind appeal to the inevitable, or a boastful trust in God, being pleaded in justification, if their conduct is challenged. I do not

think that any possible danger to the individual should stand in the way of the performance of an obvious duty, whether imposed as a legitimate personal obligation, or springing out of a benevolent desire to aid those in distress; but where so undertaken, it is clearly a duty to adopt all needful precautions for the protection of others against the spread of contagion. Is this always done? Are all classes sufficiently informed not only as to the danger, but also as to the best available measures of prevention? This is a sphere in which the clergy might exercise a vast influence for good, if well informed as to the nature of contagia, and the best methods of preventing their spread. It is to scientists we must look for this needed information, and recent discoveries in bacteriology and organic chemistry, point to a not distant future in which we may hope for more light. Till that clearer light comes, we are, I think, justified in maintaining that the violation of the moral law in such matters as temperance, chastity, and our duty to our neighbour, stands prominently forward as a fruitful source of disease. The adulteration of foods and drinks, the pollution of air and water by refuse products discharged into both by men in their haste to be rich, to the prejudice of all who use them, are sufficiently familiar illustrations.

As we cannot enforce compliance with moral laws, nor secure a strict observance of physical laws, even when tolerably clear, we must trust largely to amendments in our social laws for a remedy in such cases. Our legislators have done much of late to amend the laws for the protection of the public health; and if the bar and the bench could be induced to add their influence in simplifying procedure, much would be gained. The Archbishop of Canterbury is reported to have said, in addressing the British Medical Association, at Birmingham, lately, that:—"the three great professions occupied the three chief fields of practical thought. They were the self-revelation of God to man, or religion; the equitable relations of man to man, or jurisprudence; and the mystery of the life of man itself, or medicine." A cynical world, less philosophical than the Archbishop, and less charitable to the professions also, is prone to regard man as a chattel, the care of which is monopolized by the three faculties:—the clergy undertake for his soul; the doctors for his body; and the lawyers for his worldly possessions. Of the three the lawyers seem to be the more successful, for while wealth increases by leaps and bounds, the moral and physical condition of the great mass of the people lags sadly behind. How is this to be remedied? United and well-directed efforts on the part of the learned professions in the cause of public health will do much to dissipate ignorance, and create a

healthy public opinion on the importance of sanitary legislation, and the due administration of all laws bearing upon the health and physical condition of the people, and more especially of the working classes. But more is needed. The people must be up and doing. Lessons in personal and domestic hygiene must find a place in the curriculum of the elementary schools, before we can hope for the realization of all that is practicable in the prevention of sickness and the prolongation of life. Mental, moral, and physical culture must go hand in hand in the training of the children of all classes, if we desire to retain that racial supremacy of which we are at present so confident.

The chief point to which I desire to call attention this evening is the wastefulness of ignorance in regard to sanitation in general, and domestic hygiene in particular; and the ample financial returns which all may realise by grappling vigorously with the whole question of disease prevention, the practicability of which The Sanitary Institute is yearly endeavouring to bring home more clearly to the masses of the people. Of the excellent work done in this direction, the development of these annual congresses is, perhaps, the most practical. They demonstrate the importance of sound sanitary principles in every detail of domestic life. The papers read at these meetings, and published in the Transactions, and the valuable body of vital statistics and health reports compiled from the writings of Dr. Farr, and Sir John Simon, and now made easily accessible to the public by The Sanitary Institute, are efforts in this direction of which any society might be proud. And yet we are still at a loss for reliable data on which to base accurate calculations of the suffering and loss entailed upon the people by preventable disease. The facts as to mortality have been carefully noted, and tabulated with great advantage to the public, but the facts regarding sickness, apart from mortality, are only approximately known. It is in this direction that the labours of the medical officers of the army have proved of value to sanitary science, and it is to the results of these labours, as set forth in the reports of the medical department, that I now wish to direct your attention.

Those of you who have studied these volumes are aware that it is customary in the army to record every form of illness, however casual, which renders the soldier unfit for duty. These records are subsequently collated by the medical officers, and tabulated for transmission to the War Office. The vast aggregates of facts so collected have been carefully compiled and published in reports which have been annually presented to Parliament since 1859. The facts so recorded are as reliable as any statistics of a similar character can be, so long as any grounds for differences of opinion in matters of diagnosis

remain unsolved. Making a liberal allowance for such doubts, the statistics of sickness in the army form a convenient basis for estimating the loss entailed upon the people by preventable disease.

Turning to the report on the health of the Army for 1888, just pnblished, I find the average strength at home and abroad was 198,851; the admissions into hospital were 193,233; deaths 1,845; discharged as invalids 2,776; constantly non-effective from sickness, 10,715. Taking the United Kingdom alone the numbers were:—average strength 101,695; admissions 75,345; deaths 570; discharged as invalids 1,641; constantly non-effective from sickness 4,520. The average sick time to each soldier in the army at large during the year was 19·90 days; in the army at home 16·27 days. If to this be added the probable duration of the non-effectiveness of men invalided, who pass into civil life while still unable to earn a livelihood, the average sick time would be considerably increased, probably to the extent of twenty days per man per annum. Stated in round numbers, the loss to the army from non-effectiveness through sickness, is equal to a force of 10,716 men. Assuming the cost of each soldier to be one pound per week, or £52 a year, a very low estimate, this loss from sickness amounts to the very considerable sum of £557,232.

Some 30 years ago, while serving as a regimental surgeon in Secunderabad, I attempted an analysis of the disease factors at work in producing the sickness then prevalent in the corps under my medical charge. The late Professor de Chaumont gave a brief resumé of the result, in his Address to the Congress at Leicester, in 1885, from which I quote the following paragraph:—

"Taking all the factors together to value 100, those which were due to errors beyond the control of the individual, but remediable by the authorities, were taken to value, 35; personal errors under the control of the individual himself, 34; agencies undefined and contingencies, 6; peculiarities of climate, 25; so that 69 per cent. was regarded as distinctly remediable, and only 25 as due to climate." Professor de Chaumont adds, "this was a quarter of a century ago, I think that in the present day climate would figure for even a smaller amount." Although the word climate, as used by me in this analysis of disease factors included other influences not strictly climatic, but equally beyond human control, I see no sufficient reason after a further lapse of time, to take exception to Dr. de Chaumont's criticism. On the contrary, I am disposed to concur with him in the very definite opinion expressed further on in the Address from which I have quoted, that, putting aside the West Coast

of Africa and other pestilential spots specially dangerous to life, "we may confidently say there is not a spot on the globe where men may not be kept in health and vigour by proper attention to hygiene."

Applying the same principle of classification to men of similar ages, and subject to similar influences and disease factors in civil life, it is possible to make a tolerably accurate estimate of the actual loss in money entailed upon the wage-earning classes by preventable disease. True we have no trustworthy record of sickness among civilians, nor is it likely that we will ever be able to apply the numerical methods, so valuable in the study of vital statistics, to such attacks terminating in recovery. Something is done in this direction by benefit societies, sick clubs, and other labour organizations; and much more might be done with advantage by the great companies and large employers of labour. The coming International Congress of Hygiene and Demography, which includes the study of the life conditions of communities from a statistical point of view, will, it is hoped, throw much light on this important point. Meantime, and till some such record is available, we must be satisfied with such approximation to truth as we may be able to obtain. Sir James Paget delivered an address at the Health Exhibition in 1884, in which he established, on reasonably conclusive evidence, that the loss from sickness, between the ages of 15 and 65, in England and Wales, amounted to about 20,000,000 weeks' work in the year, or about one-fortieth part of the work done in the year by the whole population between these ages. Rather more than half this loss falls upon those whom the Registrar-General describes as the domestic, agricultural, and industrial classes. Valuing these lost services as equal, on an average, to one pound per individual per week, the amount at which the soldier's services have been valued, the loss to the annual wealth of the country from sickness among these classes alone amounts to £11,000,000 sterling. Of the other classes who lose the remaining 9,000,000 weeks' work, it would be hard, Sir James adds, to make a guess in any known coin; for these include our great merchants, judges, lawyers, clergy, medical men, statesmen, legislators, poets, writers, musicians, painters, philosophers, and princes, who certainly do more for the wealth and welfare of the country than can be told in money. These estimates do not include the still greater loss inflicted upon the people by the premature death of our most industrious bread-winners, at an age, too, when they are most productive; nor do they touch the cost of subsistence and nursing, and other sources of expenditure which spring out of sickness; or the sorrow and suffering of the widow and orphan left desolate by such bereavements. Sir

Edwin Chadwick considered Sir James Paget's estimate of loss too low by many millions, and that the burden of taxation, arising from this cause, is three times greater than the poor rate. "In London this burden, from preventable disease, was £700,000 a year at a very moderate estimate."

I pass over the burdens entailed on the productive classes, by the vast numbers of halt, blind, imbecile, epileptic, and insane—waste products in too many instances of inconsiderate marriages, and the evil effects of depraved moral and physical surroundings to which they have been exposed during infancy and youth. This is undoubtedly great, and much of it is obviously attributable to violation of those moral, physical, and social laws, which should govern the rearing of the young.

Here then is a mine of national wealth, or I should perhaps more appropriately describe it as a river of national waste of almost incalculable value, and in which every member of the community has a direct personal interest, daily and nightly passing our very doors, which a united and intelligent effort ought to be able to stem.

There is one other aspect of the condition of the people upon which the Reports of the Army Medical Department throw considerable light. Turning again to the Report for 1888, we find on pages 32 to 41 a careful analysis of the recruiting statistics for the year. From this it appears that 49,172 men offered themselves for enlistment, of whom 23,571, or nearly one half, were rejected. Bearing in mind that the ages within which recruits are enlisted range from 18 to 26, and that all those who are suffering from obviously disqualifying disabilities are refused by the recruiters and do not therefore come before the Examining Medical Officer, these figures are sufficiently startling. In order that the significance of rejection may be more clearly understood, it is desirable to recapitulate briefly the *minima* as to standard. These are, height 5 ft. 4 ins., chest girth 33 ins., weight 115 lbs., with a power of relaxation of all three in favour of likely lads who are still growing. Making liberal allowance for rejections on account of age and other causes not necessarily implying defective development, or unsoundness of constitution, these figures indicate grave defects, if not something worse, in the genesis and rearing of the lower orders of the people from whom the recruits are drawn. Much is no doubt attributable to moral influences not usually included within the purview of the sanitarian, but much is also due to unwholesome physical surroundings which call loudly for amelioration.

The limits of an address on such an occasion as the present do not admit of more than a passing allusion to the methods by

which this amelioration is to be secured. Nor can I venture upon an examination of the etiology of preventable diseases, although without clear knowledge on this point sanitary progress must be seriously retarded. The subject is too important, however, to be passed over in silence. Take, for example, the so-called infectious diseases, the immediate causes of which have long been held to be entities endowed with vital properties—a *contagium vivum*, as maintained by Hufeland. To Henle we are indebted for the earliest clearly-expressed views regarding the relationship of micro-organisms to these diseases. The micro-organisms which have as yet been recognised as existing agents of fermentation and putrefaction, or of disease, belong almost entirely to the lower fungi. Their agency in causing and spreading disease is, Flügge points out, limited, in some cases, by the fact that the multiplication of infective material takes place only under given conditions, and requires the active intervention of the individual, in whose person the contagion is so multiplied, to transmit it to others. There are, however, contagia which retain their vitality in the surroundings of the sick, after they are given off from the body, and are therefore capable of transmission, not only by direct contact, but by other transporting agencies, although the multiplication of the infecting material takes place only in the body of the sick. These are classed as obligatory parasites, and include such diseases as small-pox, measles, scarlatina, tuberculosis, glanders, diphtheria, and many of the infective diseases of wounds.

"But there are also contagious infective agents which can lead a saprophytic existence on the dead materials in our surroundings, and must therefore be classified as facultative parasites. In this case there is a multiplication of the sources of infection outside the body of the patient, and this may go on to such an extent in our surroundings, that there are, in fact, more chances of infection by infective agents produced outside the body, than by direct or indirect transmission by indifferent objects of the infective agents given off from the patients." (Flügge.) To this group belong the bacillus of typhoid fever, cholera, and anthrax; but the distinction between this and the previous class is not of such great importance as is the fact that both classes possess considerable resisting power, and are dangerous in proportion to the duration of their survival.

There is still another class of infective agents presumably located in our surroundings, which, finding access into healthy individuals, multiply there and cause disease, although such disease is of a non-contagious character. The most important representatives of this group are the infective agents of malaria.

Without following further the very interesting researches of

Flügge and others into the nature and habits of these disease-producing organisms, or noticing the views of Pettenkofer that such organisms, as they pass from the sick, are not capable of causing disease till they have first acquired infective properties in a suitable soil, I pass on to notice briefly two other points of great importance, viz., the surrounding conditions to which allusion has been frequently made, and the no less important question of predisposition, which makes a man a prey to such organisms.

Bearing in mind the saprophagous character of some at least of these organisms, there is presumptive evidence in favour of the views held by some, that after all these microbes are in the main scavengers, and that it is only when the healthy human frame has been in some way weakened that they are able to find a lodgment in it. But however this may be, it is obvious that the removal and destruction of all decaying organic matter is clearly indicated. Starve the microbe and save the man. In one particular this important principle is too often neglected: I allude to the present system of dealing with house refuse, which is in many instances a convenient and attractive nidus for such organisms, and an effective vehicle for their spread. Dr. Louis Parkes has dealt so admirably with this subject in his excellent manual—"Hygiene and Public Health," the second edition of which has just been issued, that I cannot do better than refer you to it for further particulars. Dr. Parkes truly says, "The best method of getting rid of dust-bin refuse is to burn it," and he gives a description of a destructor furnace which seems to be well suited for the purpose. The Jews, more advanced in sanitary precautions than most nations, were well aware of the purifying power of fire. Would that we too had a *gehenna* in every locality in which people are permitted to shoot rubbish! There would be fewer complaints regarding the foulness of the sub-soil, or the made ground on which the modern *jerry builder* is permitted to erect his speculative blocks of artisans' dwellings.

Similar observations apply with equal force to the laundry system of this country. In too many instances foul linen and other articles of wearing apparel, &c., are handed over to a laundress ill equipped for dealing with such articles, even when not laden with the germs of contagious diseases, but when so tainted, how inadequate is the provision for the purpose? This industry offers a promising field for the judicious investment of capital, with the certainty of good returns, to those who may be induced to embark in a well considered scheme.

While I write, the press is loud in its complaints regarding the state of the kitchens of many of our places of public resort

and entertainment, to which might probably be added other places in which human food and drink are prepared. It is especially to be desired that all such places should be subject to periodical inspection, and official supervision by competent persons of probity and position, beyond the range of temptation to overlook abuses.

But of all the causes which contribute to the origin and spread of preventable disease, overcrowding is perhaps the most important. This evil is met with in its most mischievous forms in large centres of human industry, where, for want of space, buildings are crowded together, and carried up to undue elevations; and where the prospects of employment at high wages attract numbers of the working classes greatly in excess of the available accommodation. Nothing short of prohibitive legislation will check this. Every human habitation, whatever its height, should have open spaces in front and rear, commensurate with such elevation, so as to secure a free and adequate supply of both air and light to every part of the building; and the number of persons inhabiting such dwellings, or congregating in places of public assembly, should also be limited to that for which its aerial capacity is pronounced by competent authority to be adequate.

Another indispensable requisite is a full and continuous supply of fresh potable water of good quality. Unfortunately the rapid and progressive increase of population in our large towns, and the wasteful prodigality of past generations in the matter of water conservancy, have surrounded this question, of a full, free, and wholesome water supply, with many difficulties. Still these are not insuperable, and till they are overcome we must not rest, or admit that we are satisfied. Our sanitary engineers and medical officers of health are thoroughly alive to the urgency of our needs in this direction, and we have confidence in their ability and readiness to do all that is necessary as soon as they are clothed with the requisite powers, and provided with the means. For the first we must look to the legislature, for the second to the liberality of the nation.

Pure air and water, the direct light of the sun and absolute cleanliness, with ample space in and around our dwellings, are the best safeguards against the invasions of disease producing micro-organisms.

Of predisposition to disease and heredity, time will not permit me to say more than this:—that just in proportion to the perfection of physical development, and the normal adjustment of all the functions of the individual, will be his freedom from disease, provided his surroundings be all that is desirable in a hygienic point of view. Assuming a healthy parentage in a

climate like England, a healthy happy home, with regular mental and physical training under wholesome moral influences, and a fair provision of the necessary food and clothing, would secure to every member of the community a physical development proof against such disease-producing agencies as we have been describing. The healthy homes and suitable sanitary surroundings are not at present available for the masses, and but partially so for the classes. It is no doubt difficult to secure, at all times, a reasonably pure atmosphere in a house, the apartments of which are fully and constantly occupied, or in places of assembly liable to marked fluctuation in the number of occupants, and in the duration of occupation. Still it is important this should be done, and that other equally essential sanitary arrangements including a continuous wholesome water supply, should be secured, and to this end The Sanitary Institute is endeavouring to point the way. But it requires aid and encouragement, and I know no more hopeful source to look to for both, than the ladies. They have won their way, in the face of some discouragement, into the ranks of the most humane of all professions. I hope they will soon be found, in still larger numbers, among those whose ambition it is not only to cure but also to prevent disease.

But what evidence have we to show that sanitation has done, or can do, anything commensurate with its cost, to lessen sickness and to lower the death rate? And assuming the existence of such evidence, what are the benefits conferred upon the people at large by prolonging lives, whether young or old, whose enfeebled frames preclude the hope of much productive usefulness or gain to the community by such extension?

Turning again to the reports on the health of the army, we find that the rate of mortality among the European troops stationed in India during the half century prior to the date of the Report of the Royal Commission, was, in round numbers, 60 per 1,000; and in the army at home, about 17 per 1,000. Since then, thanks to the wiser policy pursued both in India and at home, the death rate in the army has been a steadily decreasing quantity. According to the report for 1888, from which I have already quoted, the death rate in all India was 15·20 per 1,000, and at home 5·52 per 1,000. I am not able to refer to the statistics of sickness among the troops serving in India prior to 1859, but were these accessible, I have no doubt they would shew a corresponding diminution of the non-effective rate from sickness. In this instance there can be no question as to the great advantage, even in a pecuniary point of view, of the decreasing sick and death rates, because the individuals concerned are all of the

most productive ages; and, also, because the expense entailed on the State in replacing them, more particularly in India, is very large. And yet the health of the army is not as satisfactory as it should be, nor are the barracks in anything like a reasonably satisfactory sanitary condition. Thanks to the liberality of the House of Commons and the determination of the Secretary of State for War to do all that is possible to remedy known defects, we may hope that the £4,000,000, just voted for barrack construction and improvement, will remove all cause of complaint on this score. In civil life, too, we see satisfactory results following sanitary improvements. Take an illustration from London in which such works are progressive, although still far from complete. In the quarter ending June last, the death rate was 17·3 per 1,000, of which 2·5 only was from zymotic disease. Ten years ago the death rate was 19·0, and twenty years ago it was 22·0 per 1,000. This shows steady progress, and is in happy contrast to similar conditions prior to the completion of the main-drainage scheme. In Brighton the death rate is still lower, being only 15·5 per 1,000. This is, with two exceptions, the lowest death rate of any large town in England. Still there is room for improvement, even in Brighton; and with the improved laws now on the eve of passing the legislature, there is a fair prospect of seeing the mortality reduced to 10·0 per 1,000 before the lapse of another decade.

The prolongation of the lives of the old and enfeebled, as well as of the young, is so intimately blended with the larger question of disease-prevention that it is hardly necessary to pursue it further. But were it otherwise it would not be difficult to show that, as a matter of ethics, we have no choice. The saving of life is an obvious duty, the neglect of which must, I fear, be regarded as an equally obvious crime. As Farr says, "The family, the clan, the town, the tribe, the nation, all acknowledge even now the claims of children, of the sick, of the wounded, of the infirm, to help in times of trouble. Few men refuse to bind up the wounds of their fellow men."

A word in conclusion regarding these Congress meetings. It is our hope that each meeting will leave behind it an active organisation which will carry on the good work in harmony with the parent society. The Sanitary Institute has had difficulties to contend with, and its friends have been frequently called upon to find the means needed to carry on its philanthropic work. Even now its museum is in urgent need of further development to make it what we desire to see it—a faithful record of progressive advancement in sanitary engineering to which not only the profession, but the public also, can resort

when in need of reliable means of solving sanitary doubts regarding their own domestic arrangements. Brighton is already so favoured in a hygienic point of view, that a Branch Institute established here would be in the van of sanitary progress. Should such a branch be organised, let me suggest for your motto a word which means more than even the favourite phrase of Sir Edwin Chadwick, "Wash and be clean," it is the single, but much-embracing word,

"PURITY."

SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS,

By GEORGE VIVIAN POORE, M.D., F.R.C.P.,

Physician to University College Hospital; Professor of Clinical Medicine and Medical Jurisprudence, University College, London.

President of the Section.

"The Living Earth."

Gentlemen,

I am very conscious of the great honour done to me by the Council of The Sanitary Institute, in asking me to preside over the important Section of Preventive Medicine at this Congress held in the chief health-resort of the United Kingdom.

When the Council asked me to preside, they were doubtless well aware that I held no official position as a guardian of the public health, and have never held such position; and that consequently I cannot lay before this Section any experiences in connection with sanitary administration, unless it be the experiences which we all have as citizens and ratepayers.

My only chance of interesting you seemed to lie in the choice of some subject capable of very wide application, the discussion of some scientific principle, which all sanitarians must study.

Sanitation in large cities is, at the best, a makeshift, and no high level of health is attainable, in a place where the chief object of hygienists seems to be to enable persons to live as densely packed as possible.

This prelude is necessary, because the remarks which I am about to make are addressed mainly to persons who live in the country, and who enjoy the luxury of elbow-room, and I trust that what I am about to say, will make them hesitate before they hastily copy the sanitary methods of the Town, and heed-

lessly begin to foster overcrowding, the bane of all sanitary and social virtue.

I say that my remarks are addressed to dwellers in the country, because I have taken for my subject the "Living Earth," a subject which those who live on paving stones, tarred blocks, asphalte, or macadam, have to take upon trust.

The "Living Earth"! Some of you may ask what I mean by this, and whether I intend to apply the epithet 'living' to the dark colored inert mould which the countryman sees in the fields and gardens, and the Town dweller finds in the flowerpot which holds his struggling geranium?

My reply is, "certainly." We have arrived of late years at a certain knowledge of the fact, that the mould which forms the upper stratum of the ground on which we live, is teeming with life, and as this fact seems to me to be one of prime importance to sanitarians, I propose to bring some points in connection therewith before you this morning.

It has long been recognised by agriculturists, that the upper stratum of the soil differs from that immediately below it in fertility; and in treatises on gardening (notably in that admirable work written by William Cobbett, nearly 70 years since) the warning is invariably given to be careful in trenching, not to bury the top spit of soil beneath the lower spit, because the top spit is by far the most fertile. The fertility in this case was supposed to be due to prolonged exposure to air, and the lower stratum of soil if brought to the surface, would only become fertile after a considerable interval. It is interesting to observe, that although these early writers were unacquainted with the whole truth, they had grasped the most important fact, and their practice was sound. This is often the case, and I feel sure that we act rashly when we hastily abandon the custom of centuries, because some new fact dazzles us, and distorts our vision.

In connection with William Cobbett, I will draw attention to a term which he uses, more than once in the work referred to, viz., the *Fermentation* of the soil. I have not found this expression employed by any other writer, but I have made no special search, and my knowledge of Agricultural Authors is limited. Cobbett tells us that the earth begins to ferment in the spring, and that before sowing, a thorough tilling and mixing of the upper strata of the soil is very necessary, with a view not only to the disintegration of the soil, but to a thorough leavening of the whole mass with fermentible matter. There is no doubt that this term "Fermentation" as applied to the soil is perfectly apt, as we shall find further on.

The black vegetable mould which lies upon the surface of the

earth, is largely composed of organic matter, which is not to be wondered at, seeing that every organised thing whether animal or vegetable which inhabits this globe, falls, when dead, upon the earth, and becomes incorporated with it.

This black vegetable mould is largely composed of excrement, for not only is the excrement of the larger animals being constantly added to it, but this and the varied organic debris which compose it, pass repeatedly, probably, through the bodies of animals which inhabit the earth, and especially of earthworms. Darwin in his book on Vegetable Mould and Earthworms, has forcibly drawn attention to the enormous amount of work which worms perform in the aggregate. How they disintegrate the soil. How they riddle it with burrows, which admit air to the deeper recesses of the soil. How their castings which are incessantly being thrown off, tend to level inequalities, and gradually to bury stones or whatever dead inorganic matter is incapable of solution, digestion, or disintegration. Earthworms are found almost everywhere, and they are probably the most important of the animals which live in the soil, but I need scarcely say that there are many others, and everyone who has a garden must recognise the fact, that gardening is only carried out at an enormous sacrifice of animal life, for with every thrust of the spade into rich garden mould, a death blow is dealt to many of its inhabitants.

The disintegration and aeration of the soil, which is effected by the quiet tillage of the earth-dwellers, is of the greatest importance to the agriculturist, for it is hardly conceivable that the delicate rootlets of plants could grow and extend, unless the soil had been softened and pounded by the digestive fluids and the gizzards of the earthworms and their neighbours.

Seeing, therefore, that agricultural mould has all passed through the bodies of worms, and much of it through the bodies of other animals antecedently, we shall not be wrong in insisting that this so-called vegetable mould is mainly an animal excrement. The peculiar, sticky, glutinous quality of rich mould when moistened, is probably in part due to this fact.

Although the amount of *Animal* life in the earth is considerable, it is as nothing compared with the richness of the soil in the lower forms of *Vegetable* life. The dead and excremental matter becomes the food of Saprophytic fungi, which abound in the soil to a very great extent. This must be the case, for we know that Saprophytes and their allies abound everywhere, and as the surface of the earth is the common reservoir of all forms of life, it follows that these low vegetable microbes must be more abundant in the earth than elsewhere, and more abundant at the surface than deeper down. In Watson Cheyne's editions

of Flügge's work on micro-organisms (New Sydenham Society, 1890), this is very clearly stated: "Enormous numbers of bacteria have always been found in the soil, by the most various observers. Infusions made from manured field and garden earth, even though diluted 100 times, still contain thousands of bacteria in every drop, and the ordinary soil of streets and courts, also shows the presence of large numbers. Bacilli are present in much the largest numbers; but in the most superficial layers, and in moist ground there are also numerous forms of micro-cocci."

These micro-organisms of the soil are very active in producing changes in organic matter added to the soil. These changes are usually in the direction of oxidation, occasionally the change is one of reduction. One thing is certain, that if the soil be sterilised by heat or other means, it is no longer capable of producing any chemical change in organic matter. This seems to me to be a fact of prime importance to the sanitarian. The oxidation and nitrification of organic matter in the soil is a biological question, pure and simple. It is an effect produced by the *living earth;* a process analogous to fermentation, which Cobbett seems to have appreciated.

Whether the nitrifying process which takes place in the soil, is due to one or to many varieties of microbe, is doubtful, but the latter supposition is probably correct, and experiments seem rather to point to the conclusion, that, given favorable conditions—the free admission of air to a soil which is not unduly moistened—nitrification will go on. Many attempts have been made to isolate a nitrifying organism, and one of the latest, by Professor Percy Frankland and Grace Frankland, the results of which were communicated to the Royal Society, in February 1890, appears to have been successful, for these observers isolated a "Bacillo-Coccus," the power of which in producing nitrification appears to be most remarkable. Whether this bacillo-coccus is one of many having similar power, or whether it stands alone is not known, but in any case we must regard it for the present as the "Nitrate King" among microbes.

It has been asserted that fungi of a higher class, mould fungi, are also active in producing the disintegration and oxidation of organic matter in the soil. It is possible, however, that the *Bacillus mycoïdes*, which forms threads closely resembling mycelium, has been mistaken for mould fungus. This bacillus mycoides is one of those which is constantly present, we are told, in garden soil.

It has been conclusively shown by Flügge, Koch, and others, that the microbes are most abundant in the superficial layers of the soil, and that they tend to disappear in the deeper layers.

They are practically absent in the deeper layers, unless the earth has been deeply stirred or trenched, or unless sewer or cesspool has conducted filth to the deeper layers without touching the superficial ones.

"Numerous filtration experiments on a large and small scale, have shown most distinctly that a layer of earth $\frac{1}{2}$ to 1 metre in thickness, is an excellent filter for bacteria, and hence the purification of fluids from bacteria must be still more complete in cultivated, and especially in clay soil, and where the fluid moves with extreme slowness. Further, it has been repeatedly shown, that wells which are well protected against contamination with bacteria, from the surface and from the sides of the well, furnish a water almost entirely free from bacteria; that, further, wells of water containing bacteria become the purer the more water is pumped out, and the more ground water comes in from the deeper layers of the soil."

The vegetable living mould on the surface of the earth is in short a filter of the most perfect kind. It is very rich in saprophytic bacteria, whereas the subsoil at a depth varying from 3 to 6 feet is barren of bacteria, as well as of other kinds of life. The subsoil is mineral, inorganic, and dead; the mould upon the surface is organic, and teems with life.

Anything which is thrown upon the surface of the ground soon disappears.

This is especially the case with water. The absorbing power of soil for water, varies according to its mineral constitution. Loose sand and chalk absorb water very readily, and clay less readily, but the absorbing power of vegetable mould, or humus as it has been called, is infinitely greater. Humus is said to be able to absorb from 40 to 60 per cent. of water, and to hold it very tenaciously. This is from two to three times as much as the most porous dead mineral soil is capable of absorbing. We all know that in times of heavy rain, it is infinitely rarely that we see water lying in pools on the surface of cultivated soil, whereas it soon collects on roadways and paths, which are made of dead mineral matter. The tenacity with which mould retains water, is due to the fact that the water is absorbed into the interior of millions of vegetable cells, and is not merely held by capillary attraction in the interstices between small mineral particles. It is the swelling of individual cells which forms so effectual a barrier to the passage of bacteria.

Not only water, but everything else when thrown upon the soil, disappears sooner or later. Such things as pieces of wood, or leather, about the toughest of organic materials, become softened and permeated by fungoid growth, and finally crumble away. In some parts of the country, rags of all kinds are

largely used for manure. Through the autumn and winter these may be seen lying on the surface, but when in spring the tilling of the land goes forward, and the fermentation of the soil commences, the coarsest of these rags disappear. If wood, leather, and rags disappear, leaves and animal excrement disappear as we all know far more readily. The disintegration is forwarded by birds, insects, worms, and their allies, and what was the excrement of a large animal, becomes as it were, the excrement of many small ones, until finally by the action of saprophytic fungi, these organic matters become fertile "humus," which is the only *permanent* source of wealth in any country, the source whence we derive all the materials for our food and clothing.

The question whether among the bacteria which are found in the soil, some may not be hurtful to mankind, is a question of great interest and importance. If disease-causing organisms, find their way into the soil, may they not multiply or at least continue to live, and then prove a danger to health? There can be no doubt that pathogenic organisms do exist in the soil, but their power for harm would seem to be practically very small indeed; and to regard the soil as dangerous because some pathogenic organisms may lurk in it, would be about as rational as it would be to condemn vegetable food because of the occasional dangers of hemlock, aconite, or the deadly nightshade. It is well known that if soil be inoculated into some of the lower animals, such as guinea pigs, fatal results will follow from malignant œdema and tetanus; and it is also well known that earth, and especially street-mud, if ground into wounds in the human subject, may cause malignant œdema, and the death of the victim. It is equally well known that the workers of the soil, agricultural labourers and gardeners, are amongst the healthiest classes of the community, and that they are not credited with any diseases which are special to their calling. It seems to be a fact that the great doctrine of "*the survival of the fittest*" holds good for microbes in the soil, as for all other organised things everywhere; and that organisms which flourish in the human body, languish and cease to multiply in the soil, where the conditions are unsuited for their multiplication or even for their survival. They get overgrown by saprophytic microbes, and even if they do not die the risk of their finding their way into the ground water is practically nil, for we have seen that humus is the best of filters.

The life-history of at least one microbe, which undoubtedly flourishes in the human intestine, has been very carefully studied by many observers, and it may profitably occupy our attention for a time. This is the so-called spirillum of Asiatic cholera, the comma bacillus of Koch, of which we heard so

much during the last epidemic of cholera in Europe. Whether or no this microbe be the cause of cholera, must yet be considered an open question. I bring the subject before you merely as the life-history of a microbe which undoubtedly flourishes in the human intestine, and has not been found except in association with a deadly disease. This microbe, which has been met with exclusively in the dejecta of cholera patients, is easily cultivated on gelatine or potatoes, in neutralised meat infusion, on blood serum, and in milk, its growth being unaccompanied by any disagreeable odour. Growth ceases when the infusions become very dilute, and in water growth only takes place at the margin where there is an accumulation of nutrient material. Growth is able to take place with a very limited supply of oxygen, and it is most active when the temperature is high—30° to 40° C. Koch has made the very interesting observation that comma bacilli die very rapidly when dried, a cultivation if spread out upon glass and exposed to the ordinary temperature is dead and incapable of further multiplication in a very few hours. Hence it is inferred that no living comma bacillus can exist in dust, and that the transport of *living* comma bacilli through the air is impossible.

Another factor very unfavourable to the growth of comma bacilli is the presence of saprophytes in large quantities; under these circumstances they are overpowered, and die out. "If the saprophytes are in excess in the first instance, or if the sum total of the conditions of life are not very favourable to the comma bacilli, the latter do not multiply at all, but the saprophytic bacteria lead rapidly to the death of the comma bacilli present either by using up the nutrient material or by producing poisonous products" (Flügge). If, however, the bacilli be kept moist in the absence of saprophytes, they may be kept alive for months. Low temperature (freezing) does not kill them but merely suspends their vitality; temperature over 60° C soon kills them.

If the bacilli find their way into pure running water, or wells of "pure" water, it is probable that multiplication never occurs. In the case of stagnant water, however, in the bilge water of ships, in the water in harbours, which is often extremely dirty, it is probable that the comma bacilli may retain their vitality for a much longer time; and in the case of a tank in India, "where the small amount of water was not only employed for bathing, drinking, and cooking, but also for washing the linen and for the reception of the contents of the water-closets, Koch was able to demonstrate such a large number of comma bacilli that it seemed likely they had multiplied to a great extent in the tank, and that their presence was in all probability the

source of infection of a number of cases of cholera which occurred at a later period among those persons who lived in the neighbourhood" (Flügge).

Supposing comma bacilli to exist in dejecta, what is the best way to stop their multiplication and accidental passage into drinking water? Clearly to dry them and place them with other saprophytes. If they be buried in the upper layer of vegetable mould the sun will dry them; or even if it be raining the living filter will stop their passage downwards. The growth of saprophytes will kill them; and if the ground be cultivated, the comma bacilli will be destroyed and nitrified, and pass upwards into the crop and not downwards into the wells. If, on the other hand, the dejecta be mixed with water and be taken in an impermeable pipe through the living humus of the surface, to the dead mineral subsoil where the sun does not reach to dry them, and where saprophytes to eat them up exist not, the danger of their finding their way through interstices and crevices into drinking water, appears to me to be very great indeed.

That the under strata of the soil are a very inefficient barrier against filth contamination has been demonstrated in all our large towns, and especially in London. In that city the lower rooms of the houses are almost universally below the level of the street, and the house drains leave the house at the lowest point to reach the sewer at a lower level still. As underground drains, however well laid, are sure to leak in time; their contents escape, and water continually escaping at one point is sure to work a channel for itself, and take its natural course to the nearest stream or well. Still more is this sure to happen if the house drain leads to a cesspool, a contrivance which necessity invented as soon as we had water under pressure, and began to use it as our only scavenger.

In London, a city renowned for its innumerable wells, we have had to close every one of them, and as the excessive dirtiness of the air makes rain-water not available for domestic purposes, we have become absolutely dependant upon the water companies, and it is only quite recently that the public has become alive to the fact that the causes which poisoned the surface wells, are equally poisoning the Thames and the Lea, and the other sources of London water. No thinking being can feel easy about the London water supply, and it is to be hoped that some day the public mind will be roused to an appreciation of the fact that if we want pure water we must make some serious attempt not to foul our wells and streams.

I am convinced that in our sanitary arrangements we have not sufficiently distinguished between the living mould of the

surface, and the dead earth of the subsoil. The living mould is our only efficient scavenger, which thrives and grows fat upon every kind of organic refuse; our only efficient filter, a filter which swells and offers an impassable barrier to infective particles, a filter which affords a sure protection to our surface wells. When we perforate the living humus with a pipe and take our dirty water to the subsoil, we, as it were, prick a hole in our filter, and every chemist knows what that means.

In order to keep the soil healthy, to keep up its appetite for dirt and its power of digestion the only thing necessary is tillage. Well-cultivated soil, which is compelled to produce good crops, has never yet been convicted of causing any danger to health.*

Sanitation is purely an agricultural question, and in the country, where every cottage has, or should have, its patch of garden, there ought to be no difficulty in the daily removal of refuse from the house, and in applying it to agricultural purposes, without any risk of contaminating the water supply. Given the patch of garden, the only thing necessary to bring about this, the only complete form of sanitation, is the will to do it—the will, that is, to do a profit to one's self, without the possibility of damaging one's neighbour. This, unfortunately, is rarely forthcoming, in spite of the Christian Religion and the

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* As to the power of earth upon organic fluids I have recently been making, with the able assistance of Mr. Wells, a few simple experiments, which seem to me to be very striking, and worth recording, as showing the effect produced upon urine by slow filtration through earth. Small quantities of urine (averaging half a pint) were added day by day to earth contained in a conical metal vessel, resembling in size and shape the ordinary "jelly bag" which is used in domestic kitchens, and having a perforation at the apex. The experiment was commenced on June 26th, and on July 10th, when 119 ozs. of urine had been added and the earth had become saturated, our filter began to yield us a filtrate, which differed in a very marked degree from the urine put into the filter. The results obtained may be summarized as follows:—A total of 200 ozs. of urine was added to the filter, and the total filtrate amounted to 73 ozs. Thus, 127 ozs. either remained in the filter, or was lost by evaporation; and as the experiment was conducted indoors in July, and lasted from June 26th to July 22nd, or exactly 26 days, the loss by evaporation must have been considerable. The average specific gravity of the urine used was 1021·4, whereas the specific gravity of the filtrate was always 1011, except upon one occasion, when it was 1012.

The total solids of the urine averaged 4·44 %, of which 3·45 was organic and ·99 inorganic; while the total solids of the filtrate averaged 1·78 %, of which 1·069 was organic and ·710 inorganic.

The urea in the urine averaged 2·32 %, and in the filtrate ·35 %. The chlorides in the urine averaged ·666 %, and in the filtrate ·409 %, The surface of the filter smelt from the first strongly ammoniacal, but the filtrate, although of a deep colour, was free from odour, and could be evaporated to dryness without offensive smell. The filtrate had no tendency to putrefy, nor did a drop of it, when added to sterilized urine in a tube, set up putrefaction.

Education Act, and we go on, even in country places, polluting our streams and wells, with our minds agitated, as well they may be, as to when our water will become too poisonous to drink, and where we shall turn for a pure supply in the future.

Sanitation is a purely agricultural and biological question. It is not an engineering question, and it is not a chemical question, and the more of engineering and chemistry we apply to sanitation, the more difficult is the purifying agriculture. This, at least, has been the practical result in this country.

The only engineering implements which the cottager with a bit of garden requires for his sanitation, are a watering pot and a spade, and if his garden be an allotment away from the cottage, a wheelbarrow may become necessary. The cottager, to whom the produce of his bit of land is a matter of consequence, will endeavour to fertilize as much land as possible with the organic refuse at his disposal, and as long as this endeavour is made, there need be no fear of failure, either from the agricultural or sanitary point of view. When however an engineer by means of water under pressure, has collected the organic refuse of a province at one spot, has diluted it a thousand-fold, and endeavours to submit it to a mock purification, by means of the least amount of land possible, failure is inevitable, both in the agricultural and sanitary sense. It was in 1848 that the advice to "drain" was tendered with a light heart, by the pioneers of modern sanitation, who thought it would be an easy thing to purify the sewage, and make a profit from it. The Thames, the Liffey, the Clyde, the Mersey, and the Irwell, are a standing testimony to the failure of these great engineering schemes, and I would remind you, that the last engineering scheme put forward with regard to the sewage of London, viz., to convey it all to the Essex coast and cast it into the sea, is not only a most lame and impotent conclusion, quite unanticipated by the pioneers of '48, but it is an experiment which, like our previous experiments, may be productive of unforeseen results.

The engineer of the present day when dealing with sewage, appears to think that one may "as well be hung for a sheep as a lamb," and he is ever ready to tender the advice that "if you are going to make a mess, it is well to make a big one." It is quite characteristic that this last scheme for dealing with the London sewage, contemplates dealing not only with the material which is collected by our present system of sewers, but proposes to take that of other and adjacent systems as well.

The people of Berlin have in this respect, shown themselves wiser I think than the people of London, because they have taken their sewage to several points, instead of collecting it all at one spot.

So far it is probable that the bulk of those I am addressing will agree with me, but I am not so certain that I shall command your assent to all that is to follow.

The panacea for all sanitary ills has been and still is "drainage," and the only scavenger that is in favour is water, notwithstanding the fact that sanitation by water has for its main characteristic "incompleteness." The work is begun and never finished. Our houses are flushed, but we pay for it by fouling every natural source of pure water, whether river or surface well. If there come an outbreak of typhoid, we, as often as not, find the "drains" are to blame, but as a matter of fact we prescribe "more drains" as the remedy.

I have asked my friend and former pupil, Mr. F. W. Wells, M.B., to go through the official reports which have emanated from Whitehall since 1856, and make an abstract of the chief outbreaks of typhoid fever in this country, which have been reported by the medical officers of the Privy Council, and the Local Government Board. This Mr. Wells has done in a most painstaking and methodical manner, and the tables which he has constructed form an Appendix to this paper which is well worthy of perusal. If you will scan this appendix, you will find that there is one factor common to all these outbreaks, viz., the mixing of excremental matters with water. This mixture generally leaks to the well or rivulet, or water-pipe which supplies the drinking water, which water has not unfrequently been sold under the name of milk, and the result is an outbreak of typhoid. Or the mixture putrefies in a cesspool or sewer, and the gases finding an entrance to our houses cause an outbreak of typhoid. There is no doubt whatever that whenever excrement is mixed with water, we are in danger of typhoid. Typhoid was not recognised in this country until the water-closet became common. We, doubtless, manufactured typhoid in a retail fashion in old days, but with the invention of the water-closet we unconsciously embarked in a wholesale business.

We had not been at this work many years before we recognised that the water-closet poisoned all sources of water. We have had to go far a-field for drinking water, and the result has been that, as we left off consuming the springs which we have wilfully poisoned, the amount of typhoid has somewhat abated. When the more remote sources of water get poisoned in their turn—as with our increasing population, and our methods of sanitation, they inevitably must—the present comparative abatement must, one would fear, cease.

The foregoing observations apply, be it observed, to cholera equally with typhoid.

It is comparatively recently that we have learnt to recognise

the dangers which result from the putrefaction of a mixture of excrement and water in a sewer or cesspool. The ingenuity of sanitary engineers has been exercised to save us from these dangers, and they have given us what they are pleased to call self-cleansing sewers, innumerable forms of trap, endless methods of ventilation, and disconnection on scientific lines, until the medical officer of health is expected to have at his fingers' ends all the knowledge of a patent agent and a plumber's foreman. If apparatus never wore out, if ventilators never got stopped up, if traps never got unsealed by leakage, evaporation, or other cause, one might feel secure against the enemy which is ever at our gates, provided the study of Bacteriology did not lead us to recognise that a few feet of filthy pipe may be as dangerous as a mile, and that a trap may possibly serve, especially in hot weather and when the family is away, as a most efficient cultivating chamber.

It is commonly urged by those who defend our present methods of sanitation that, as we must of necessity provide some channel for the escape of slops from our houses, it is false economy not to make these channels carry everything, or, in other words, that, as sewers are a necessity, there is no harm in making them a bigger nuisance than they necessarily must be. I confess I am unable to follow this argument, and I would submit some reasons why every effort should be made to keep excremental matters out of the sewers.

1. Excrement is the only ingredient of sewage against which dangerous infective properties have been proved again and again. It is the ingredient which, when mixed with water, finds its way to our drinking water and causes typhoid and cholera. Sewage without excremental matters is, doubtless, offensive and is probably unwholesome in many ways, but it stands in the position of a "suspect," rather than that of an habitual criminal against whom no end of previous convictions have been proved.

2. If excremental matters were stopped out of our house drains, we could in country places, often have recourse to the old practice of allowing our household slops to run in open gutters, concerning the ventilation of which there could be no doubt, and the gutters might be subjected to the wholesome discipline of a broom, and the purifying influences of sunlight and drying winds.

3. If excremental matters be stopped out of the house drains, the total volume of sewage to be dealt with would be diminished by at least one-fifth, and this surely is a great gain. We should deprive the sewage of just those ingredients which are most troublesome to the sewage farmer by clogging the pores of the ground, and we should leave the sewage very "thin" and

admirably suited for downward filtration. It seems to be an acknowledged fact that for the application of sewage to the land, the more watery it is and the more completely solid matters are strained out of it, the simpler and more satisfactory the processes become.

4. Another class of objections which has been made to the exclusion of solid excrement from house drains, has reference to the so-called "manurial value" of sewage and its constituents—that excreta without the total urine are of low manurial value, and that the stopping of excreta out of the sewers lowers the manurial value of the sewage. "Manurial value," is a term used by chemists to express the amount of nitrogen that may be present. Now I do not doubt the ability of chemists to make a quantitative estimation of nitrogen, nor their power of informing farmers of the extent to which they may or may not have been cheated when they purchase artificial manures. I would humbly suggest, however, that the real practical manurial value depends, not only upon the amount of plant-food present, but also upon whether the plant-food is present in a form in which it can be digested and exhaustively utilized by the plant. For the latter information, which is of the highest importance, I would sooner apply to a practical farmer or gardener than to a chemist.

A chemist, for instance, who had regard to his analyses and nothing else, might tell us that nut-shells had a certain dietetic value; but ordinary men and monkeys know better than that.

He might tell us that gin was richer in certain dietetic ingredients than ginger beer, but we know that ginger beer is the better article of diet.

Again guano has a far higher manurial value than "rich garden mould"—such as is got by mixing earth with organic refuse—; but if we do not dilute our guano to the same level, so to say, as our rich garden mould, we may kill our plants. To declare that rich garden mould is of low manurial value is absurd, because we know that in it plants of all kinds reach the highest development which is attainable. Farmers and market gardeners will tell you that artificial manures have "got no bottom in them," that their use is, so to say, a speculation; and if climatic conditions are unfavourable when the artificials are applied, the money spent on them is lost for ever. With organic refuse, however, the case is entirely different, and the effect of the application of organic matter, especially of human origin, to the soil, is plainly discernible for three or four years. Solid organic matter cannot be washed away, it nitrifies slowly and doles out the nitrates to the roots of the plants in proportion as they are needed.

I wish to say, emphatically, that the manurial value of human excrement is enormous, and that it produces all kinds of fruits, flowers, and vegetables in the highest perfection. I speak from a practical experience of nine years, and my belief is that soil cannot be made more fertile than by mixing it with solid excremental matter.

It is quite true, no doubt, that the manurial value of urine is very great, but being fluid it is not so easily retained at the spot where the agriculturist wants it; and we know that when fresh and undiluted it is very dangerous to herbage. The fact is that plants absorb their nutriment from very dilute solutions; and it has been found that a fluid containing about ·2 per cent. of solids, is the *optimum* for plant culture. Ordinary urine, therefore, which contains 4 per cent. is twenty times too strong; but if it be applied to the soil in its state of optimum dilution, much of the liquid will necessarily soak out of the reach of the roots.

Manurial value is a practical matter rather than a chemical problem, and I have no doubt whatever that those who assert the manurial value of earth-closet manure to be low, are making a very serious practical mistake; and I have no doubt that arguments based on the theoretical manurial value of sewage as a whole or of its several ingredients, are worthless in helping us to decide whether it is advisable or otherwise to keep solid matters out of the drains.

What use is there in discussing the "manurial value" of sewage in the face of the deliberate declaration of that eminent agriculturist, Mr. Clare Sewell Read, made a few months since in the "Journal of the Royal Agricultural Society?" "Sewage," says Mr. Read, "has come to be regarded by all sensible people simply as a nuisance to be got rid of." And he goes on to state that, owing to the unmanageable quantities of water which have to be dealt with, sewage is ruinous to all grain crops and all other farm crops except rye grass.

The composition of sewage as it flows from towns is so doubtful, and must be so variable that no sensible man would let it run over his farm. Chemicals and antiseptics are very abundant at the present day, and they are very largely used to lessen the dangers which are inherent in our present system of sanitation. Antiseptics, however, which stop the growth of putrefactive microbes, also check the growth of nitrifying organisms, and are deadly poison to plants. All town sewage is liable to contain dangerous chemicals which must render the "manurial value" a very minus quantity, the presence of nitrogen notwithstanding.

As it is idle to discuss the theoretical manurial value of a

practical nuisance, which no sane farmer would take as a gift, it is imperative for us to discover means, if possible, by which those ingredients of sewage which have great enriching power for the soil may be saved for the benefit of the cultivator and consumer.

From every point of view — scientific, sanitary, moral, economic—I feel strongly that dwellers in the country should take warning by the towns. They should revert to the cleanly and decent habits of our forefathers, and keep the sanitary offices away from the main structure of the house, and not, as is the filthy custom of the present day, bring them almost into the bedrooms. They should keep solid matters out of the house drains, and see that they are decently buried in the living earth every day, and they should replace the drains by gutters and filter all the household slops by applying them to the *top* of a different piece of cultivated ground every day. Whether an ordinary watering pot, or a tank upon wheels drawn by a horse be necessary for accomplishing this latter object, will depend upon the size of the establishment; but only those who have systematically pursued this plan, as I have done, can know the vigour which is imparted to hedge-rows, shrubberies, fruit trees, or forest trees, by a tolerably frequent dose of household slops. There is no difficulty in doing this, provided the will be present —the will that is to combine your duty towards your neighbour with an act which is profitable to yourself.

Finally, you dwellers in the country, whether Squires who are the owners of broad acres, or Occupants of modest villas with a garden, or still more, if you be Cottagers with an allotment, where it ought to be, round your cottage, what I have to say to you is this :—

1. That sewage, being a nuisance although a necessity, it is to your interest not unnecessarily to increase its quantity or its offensiveness.

2. Keep solid matters out of the drains, for by doing this you will prevent the putrefaction of the solid, and you will find the purification of a liquid by filtration through the earth is effected with ease, which is proportionate to the thinness of the fluid.

3. Remove all solid matter every day from the immediate neighbourhood of the house, and bury it in the top layer of cultivated ground. Pour the household slops on to the surface of the garden, and do not make the mistake of attempting what is known as subsoil irrigation. If these directions be followed I feel sure that by no possibility can you be troubled by sewer gas, and I also believe that you may drink the water from your surface wells with safety.

I am, as some of you know, no mere theorist, I practice what

I preach, and have now some nine years' experience, experience which has served to strengthen my opinions and enables me, unreservedly to exhort others to pursue a similar course with myself.

In Hampshire I have a garden, and adjoining it are twenty cottages which I also own, inhabited by about a hundred persons. These cottages are scavenged *every day*, and the scavengings are buried in the garden. The scavenger's first duty is to the cottages, to remove filth and bury it, to whitewash, paint, and to keep decent. His second duty is to the garden, where he acts as under gardener. In the garden, which has an extent of about $1\frac{1}{4}$ acres, I am obliged in self defence (what a hardship!) to raise the biggest crops possible. This garden not only supplies my London house with a variety of fruit, flowers, and vegetables (cabbage, potatoes, carrots, turnips, parsnips, beet, salsify, lettuces, artichokes of both kinds, peas, beans, asparagus, seakale, peaches, plums, apples, pears, figs, strawberries, currants, raspberries, &c.), which I doubt if I could purchase for £50 a year of the neighbouring greengrocer, but the overplus, which is marketable, just about pays the wages of the scavenger and under gardener. I cannot help thinking that the combination of market gardening with cottage owning in country places, opens up the possibility of an industry which is at once profitable and advantageous to all concerned, and affords a good chance of solving a sanitary difficulty.

I am addressing myself to dwellers in the country, but I should like to say to town dwellers that complete sanitation is impossible, unless cultivated land be brought into tolerably close relationship with the dwelling. At present our sanitary arrangements are magnificently begun, and seldom completed, and while we almost uniformly leave a most dangerous loose end to our sanitary measures, we shut our eyes to it, and blow the trumpet of self-satisfaction as if the sanitary millenium had begun. The Allotment Act as affording an outlet for organic refuse, ought not to be without its effect upon sanitation, and it is to be hoped that the masses will some day wake up to the great importance, from the moral and sanitary standpoint of providing every dwelling with an adequate outlet. As things go at present, I have very little doubt that the agricultural labourer with his cottage and garden and 12 shillings a week, is infinitely better off than the town artizan on 25/-, who pays dearly for pigging it in overcrowded rooms, in which a cleanly and decent existence is impossible.

I have been reading the last volume of our transactions, and in it I find a very interesting paper by Dr. Sykes, who quotes Dr. Corfield, who, in his turn, is quoting Sir Henry Acland to

the effect, that the disappearance of the great cities of antiquity was due to pestilence, rather than war. We must all admit the possibility of such an assumption, and certainly no one can ponder upon the disappearance of Egyptian, Babylonian, Assyrian, Greek, and Roman civilization, without speculating upon the cause, and without applying the lesson to ourselves, and asking ourselves how much longer is our British civilization to continue?

Nationalities seem as mortal as the individuals which compose them.

If great nations are destroyed by neglect of sanitary laws, and if prolonged national life is indicative of sound sanitary measures there is at least one race upon the globe which is worthy of profound study by all who concern themselves with public health. This race is the Chinese, who have seen all the great nations of antiquity in and out, who were probably a great people in the days of Moses and before, and whose thrifty myriads are even now successfully contending with the Anglo-Saxon race, in America and Australasia. The Chinese, as is well known, have had to contend with national calamities of a most stupendous kind. In our own days we hear of floods and famines which claim their millions of victims, and yet the race continues to increase in such a way, and to overflow its natural boundaries to such an extent that it is certain, even without the exact returns of a Registrar-General, that the birth-rate must very considerably exceed the death-rate, and must have done so in an average way during the three or four thousand years that the Chinese nation has existed.

I think there is no doubt that unless we mend our ways, the Chinese will see us out, as they have seen the other great nations of the world out, and the reason, I believe, is obvious. The Chinese are the most thrifty nation in the world. In China nothing is wasted, and all organic refuse is ultimately returned to the soil. Agriculture is in China a sacred duty, and the Chinese have got a firm grasp of the elementary principle that if the fertility of the earth is to be maintained, we must constantly replenish it. The nineteenth volume of the Health Exhibition literature contains a most interesting series of papers on China, by Surgeon-General Gordon, Mr. Hippisley, and Dr. Dudgeon, of Pekin. The papers by Dr. Dudgeon are especially worthy of study, for many years of residence among the Chinese have impressed him with the fact that we have much to learn from them. I have not the pleasure of Dr. Dudgeon's acquaintance, but, were he here, I am sure he would give a general support to the propositions I have laid before you.

The question of our duty to the soil is fundamental in sanitary matters. If we starve the soil and turn our fertilizing materials into the sea, we may rid ourselves (though this is doubtful) of filth diseases for a time; but it is by no means doubtful that we shall ultimately replace filth diseases by those diseases that are bred of starvation. How soon this will happen no one can say, but that it will happen eventually seems to me as certain as is the axiom, "ex nihilo nihil fit." Do not let us commit the great blunder when dealing with this national question, of forgetting that the life of a nation ought to be measured by centuries; do not let us make a suicidal use of a paltry 50 years statistics, and because the figures of the last decennium happen to be favourable, conclude therefrom that all our sanitary principles are right.

Perhaps someone will say, "How ridiculous to hold up the Chinese as an example! The Chinese masses are acknowledged to be exceptionally filthy in their customs and habits." This, perhaps, is true, but I am sure that this audience will not make the error of confounding principles with details. The Chinese principle of returning all organic refuse to the soil is, there can be no doubt, absolutely sound. The Chinese details may be filthy and susceptible of improvement. In this country the details of our domestic sanitation are refined, elegant, and ingenious. It is the principle subserved by these details which is absolutely rotten. The main problem of sanitation is to cleanse the dwelling *day by day*, without fostering starvation. This can only be done by returning all organic refuse to the soil, and the perfecting of the details by which this duty is to be done is the most important work of the modern sanitarian.

This question is a national one and concerns us all. Every country squire ought, in these matters, to set a good example to his tenants. If he does not set the example of increasing the fertility of the soil by the daily addition to it of all the organic refuse of his country mansion, he cannot command our sympathy when he goes without his full rent. If a landowner embarks on a great building scheme, he ought to keep the sanitation in his own hands. If a well-known landowner had done this—if he had preserved his autonomy on his own estate, and if he had, by a rational use of the railway, transferred the daily scavengings of his valuable City estate to his broad acres in Bedfordshire, perhaps his right-of-way on his London estate would not have been confiscated, and perhaps he would not have been obliged to remit 25 per cent. of his Bedfordshire rental. As it is, he allowed the vestry to do his sanitation for him, and by so doing lost his autonomy. Who can see how far the process of confiscation which has set in will ultimately reach?

This question has an immediate personal interest for all who derive their income from the soil. I feel sure that the clergy would do well to enforce by example as well as by precept the old injunction, to "replenish the earth and subdue it." If they do not they must expect to go without their tithes. Improvement in this direction is only to be attained by rousing the public conscience. So soon as the majority of individuals is impressed with the fact that it is wicked to foul our streams and starve the soil, and that our individual responsibility does not end, even though the fouling and starving be done by a "Board," so much the better will it be for the public health and national wealth. Parliament has compelled us to hand over our responsibilities to public authorities, with the consequence that the individual has lost his liberty and independence, and is drifting into a condition of sanitary imbecility. Let us not forget that the present state of our rivers is the direct result of Acts of Parliament. Let us not forget that Parliament, which wasted its time and our money in passing that most inoperative of all Acts, the "Rivers' Pollution Act," scavenges its own palace direct into the Thames; as though Imperial Parliament could hand over its responsibilities to a Local Board! It is hardly credible that such a condition of things could exist outside the libretto of a comic opera.

A respect for the purity of water should be enforced in our board schools and churches; and that powerful party in the State—I mean the temperance party—would do well to devote some of its energies towards ensuring that the beverage which it champions should be in all places a safe one to drink. As it is one has only to walk about the country to see that our streams and rivulets are universally regarded as receptacles for rubbish and impurities of every kind.

This question I must reiterate, in conclusion, is a national one of the first importance. A nation that fouls its streams and starves its soil is in danger of poisoning and inanition. A nation which imports a great part of its food and a great part of its manure, and systematically and by Act of Parliament throws all its organic refuse into the sea, is undoubtedly living on its capital. Our capital just now is undoubtedly considerable, but we are in a fair way to run through it; and when we have done so who can forcast the future.

APPENDIX.

EPIDEMICS OF TYPHOID.

* *Tabulated from the Reports of the Medical Officer of the Privy Council and Local Government Board.*

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1858	Windsor.	400	26.	Mr. Austin.	Slovenliness as to removal of filth; offensive pig-sties; unregulated slaughter-houses; unremoved refuse; obstructed surface drainage. Three-fifths of the houses supplied from surface wells, sometimes in proximity to undrained premises, or imperfect drains. Sewerage without adequate exterior ventilation, and so ventilating itself into houses. On account of the summer drought, the sewer atmosphere at maximum of poisonousness.
1859	Kirkby-Stephen.	$\frac{1}{7}$ of the 1,500 inhabitants.	11. (Typhoid or Typhus?)	Dr. Ord.	Bad drainage. Sewage draining into drinking-wells. Accumulation of excrement in proximity to houses.
1859-60	Bedford. (Autumnal epidemic for some years.)		30 per annum from fever & diarrhœal diseas's	Mr. Austin and Dr. Whitley.	Water contaminated with decaying animal matter. Cesspools universal—upwards of 3,000 of them. Water-supply from wells frequently in close proximity with cesspools. Water both in cesspools and wells rises and falls with river.
1860	Bath. (Bathwick.)	35 houses.		Dr. Whitley.	No sewerage. Cesspools general. Defective house drains leaking beneath houses. Fæcal putrefaction in air and drinking water.
1859-60	Kingston-Deverill. (Wilts.)	66 (out of population 400).	6.	Dr. Whitley.	First contagium imported. Badly-ventilated houses. Not attributed to sewage-tainted water or sewage-tainted breathing air; probably to want of precaution in dealing with evacuations.

* This Table has been kindly prepared for the Author by Mr. F. B. Wells, M.B.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1859-60	Dronfield.	556 (out of 2,500 inhabitants).	41.	Dr. Ord.	Sanitary neglect. Accumulation of animal filth in privies, cesspools, pig-sties, slaughter-houses, and drains. Drainings soaking through house walls. Refuse draining itself to dammed-up brook in valley; two much-frequented wells habitually in danger of pollution from this brook.
1861	Calstock. (Gunnislake.) (See also 1871, p. 57.)	213,	12.	Dr. Bristowe.	Accumulation of excrement, slops, and decaying animal and vegetable matter. Deficient privy accommodation. No efficient house drains or sinks. An unusual number of filthily-kept pigs and of putrid and overflowing refuse pits and heaps.
1861	Over-Darwen. (See also 1874, p. 62.)	1,000.	35 (some of these registered as "Typhus").	Dr. Greenhow.	No system of drainage, or of scavenging. Night soil, ashes, and general refuse allowed to accumulate for months and years. Overcrowding. Water and liquid refuse making for themselves channels in the unpaved streets.
1861	King's Langley.	16.	2.	Dr. Ord.	Drains opening near cesspools pass between or beneath houses; in hot weather offensive stinks proceed from these drains. Drinking-wells in danger of contamination from cesspools. Filth and excrement allowed to accumulate from deficient scavenging.
1861	Yeadon.	130.	11.	Dr. Ord.	Deficient privies and deficient scavenging. Drains communicating with dam whence water is pumped to mills, and there boiled for trade uses. Open gutters, into which slops are thrown. One drinking-well liable to sewage fouling.
1863	Whitehaven.	1,000.	110 (including 17 registered in St. Bees).	Dr. Bristowe.	Overcrowding. Bad ventilation of houses. Bad privy accommodation. Bad scavenage. Practically no drainage. Absolutely none for water-closets. Gutters running down courts carry off surface water, and whatever else may happen to escape from middens, piggeries, &c., or be thrown therein.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1863	Festiniog.	600-700.	67.	Dr. Buchanan.	Great majority of houses without privies or ash-pits. Fields and house utensils are used—the latter being emptied near the houses. Streams in valley polluted by rain water washing down excrement from houses. This water-supply only used for domestic and not drinking purposes. Drinking water from mountains free from pollution. Great overcrowding. Cold and wet attributed as causes. Such privies as exist are generally offensive.
1863-4	Grantham. (Including Spittlegate.)	Not ascertained.	22.	Dr. Bristowe.	Impure water. The drinking water (spring water) became mixed with the river water. This latter receives part of the drainage of a village. In most cases the effluvia from accumulated human excrement are blamed, from untrapped drains, imperfect sewers, and bad system of privies.
1865-6	Buglawton.	150.	14.	Dr. Buchanan.	Only superficial sewers, receiving rainfall, house slops, and in some cases midden excrement. Foul smells from untrapped sewers. Middens in common use, but scavenage very bad. The river dam receives the sewage of many houses, and from this river near where sewage enters, water for domestic use is obtained. Drinking water from well liable to contamination from privies adjacent. Water analysis proves the contamination. "Facts point to specific contamination of the well water by typhoid poison, derived from the first patient in the house adjacent to the well."
1864-5-6	Tottenham. (Page Green.)	100.	2 or 3.	Dr. Seaton.	Where fever occurred, the drinking water was wholly or in part from surface wells. Some of these wells liable to surface and sewage contamination. Water analysis showed organic impurity.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1865-6	Winterton.	100 (ex. 145 inhabitants).	17	Dr. Thorne.	Disgraceful state of privies, cesspools, ashpits, and wells. Contents of privies running into gardens, often penetrating into the wells. Refuse, slops, urine thrown into yards, or deposited in open cesspools. Urine and bowel discharges of typhoid patients thrown into open ash-pits. These sources of fæcal fermentation situated close to the houses, and in immediate vicinity of wells. Untrapped drains communicating with main sewer evolving stinking effluvia. Within a circuit of 14 feet round a drinking well are an open drain, an open ash-pit, two pigsties, three privies, and one open cesspool, all (except the drain) raised from $1\frac{1}{2}$ to 3 feet above the well, and situated on a loose porous soil.
1867	....	55	6		
		155	23		
1867	Guildford.	500.	21.	Dr. Buchanan.	Sewer receiving mainly surface water, receives also excreta from certain water-closets, and the overflow of certain cesspools; some privies also discharge their liquid excreta into this sewer. Sewer runs within 10 feet of well, and by percolation and by a fissure in the chalk, excrementitious matter leaked from the sewer to the well.
1867	Terling.	300 (ex. 900 inhabitants).	41.	Dr. Thorne.	Slops, ashes, manure-heaps, broken-down privies and cesspools surround the cottages; drinking water is obtained from wells at a lower level, and separated by loose porous soil from the above nuisances. The remaining drinking water is got from ponds into which drainage from the fields and roads run, or from river water contaminated by sewage. Overcrowding everywhere.
1869	Wicken-Bonant.	45.	4.	Dr. Buchanan.	Privy of first house affected with typhoid stands on edge of water channel; the undisinfected stools were thrown into the privy; thus the excrement got from privy to brook, and the brook communicated with the parish well. The method of infection in the first patient is uncertain, but was caused in some manner by typhoid fever previously imported from London.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1870	Annesley. (Notts.)			Dr. Buchanan.	Arrangements for excrement disposal and water supply such that people must drink their own excrement.
1870	Appledore and Northam. (Devon.)			Dr. Thorne.	Streets and courts ill-constructed and ill-drained, with excrement and refuse lying about everywhere. Water sources befouled. "Epidemics of enteric and scarlet fevers."
1870	Coventry. (Neighbourhood of.)			Dr. Thorne.	"Enteric fever seriously prevalent." Ascribed to use of polluted water, want of efficient sewerage, and various accumulations of filth.
1870	Croyde. (Devon.)			Dr. Home.	"Serious prevalence of enteric fever." No public sewerage or house drainage. Excrement and refuse accumulations. Pigsties and dung-heap nuisances, sometimes polluting the water.
1870	Penryn. (Cornwall.)			Dr. Thorne.	"Considerable outbreak of enteric fever." Streets lined with excrement and refuse. Want of sewers, privies and ash-pits. Water sources polluted.
1870	Rolvenden. (Kent.)			Dr. Thorne.	"Enteric fever epidemic." Water supply polluted. Want of drainage and proper means of excrement disposal. Abundant nuisances.
1870	Spinkhill. (Derbyshire.)			Dr. Thorne.	"Habitual prevalence and present outbreak of enteric fever." Water of public and other wells polluted. Drains defective. Want of privies and ashpits. Filth accumulations.
1870	Ystrad-y-fodwg (Glamorgan.)			Mr. Radcliffe.	"Great prevalence of enteric fever." Neglect of all sanitary precautions. No due provision for excrement or refuse disposal. Water supply insufficient and liable to pollution.
1871	Brackley. (Northampton.)			Dr. Buchanan.	"Epidemic of typhoid." Accumulation of excrement. Wells near cesspools.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1871	Bulwell. (Notts.)			Dr. Harries.	"Epidemic of typhoid." Pollution of water by excrement nuisances. Privies filthy and insufficient.
1871	Burbage. (Leicestersh.)			Dr. Harries.	Epidemic of typhoid fever, connected with use of water from a well communicating with a privy probably infected by an imported case of typhoid. Bad excrement management, and improper water supply generally.
1871	Calstock. (Cornwall.)			Dr. Blaxall.	Frequency of typhoid epidemics. Continuance of unwholesome conditions previously reported. (*Vide* 1861.)
1871	Carlton. (Notts).			Dr. Harries.	"Enteric fever epidemic." No proper water-supply. Privies few and bad. Nuisances abounding.
1871	Helions-Bumpstead. (Essex.)			Dr. Airy.	"Epidemic enteric fever." Great accumulations of excrement and filth. Foul ditches. Much of water-supply polluted.
1871	Higham-Ferrers. (Northampton.)			Dr. Home.	"Habitual prevalence of enteric fever." Ground sodden with leakage from privy pits and cesspools. Water polluted. Insufficient ventilation of sewers. Accumulations of excrement and house filth. Trade nuisances.
1871	Hugglescote. Donnington. Coalville. *Packington. (Leicestersh.)			Dr. Home.	"Enteric fever severely epidemic." Air and water polluted by excrement. No proper drainage. Nuisances from privies and pig-sties.
1871	Ilminster. (Somersetsh.)			Dr. Blaxall.	"Considerable epidemic of enteric fever." Foul open sewers. Excremental filth everywhere, saturating ground and contaminating most of drinking water.
1871	*Packington. (Leicestersh.) (& Derbyshire.)			Dr. Home.	"Severe epidemic of enteric fever." Water-supply polluted. Serious accumulations of excrement and other filth.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1871	Sunderland.			Mr. Radcliffe.	"Epidemics of typhus, typhoid, and small pox." Overcrowding. Defective drainage. Improperly regulated water-closets. Excremental nuisances. Defective water supply.
1872	Ashton-in-Makerfield. (Lancaster.)			Mr. Radcliffe.	"Epidemic of typhoid fever." Insufficient water supply, and partly from questionable sources. House drainage bad. Accumulations of excrement. Want of scavenging.
1872-3	Sherborne.	243.		Dr. Blaxall.	Water in surface mains exposed to contamination from water-closets by excrement and sewer air. In some cases the specific contagium of typhoid would thus enter the water-pipes. This entrance to the water-pipes was made possible on account of the water supply being itself shut off near the supplying reservoir. Water-closets defective: filthy privies in the town with large pits, producing soil saturation and air pollution. Inefficient sewerage and drainage. Overflow of bath pipes (in some instances) communicating with soil pipes or drains. Remains of old sewers and dead wells in the town evolving foul smells. Public water supply good, but in addition several wells exist in the town exposed to contamination from soil of privy pits or leakage from old sewers.
1872	Armley.	107.	11.	Dr. Ballard.	Defective drainage. Large privy cesspools the usual thing. The earth upon which the dwellings stand is polluted with soakage from drains and cesspools. Typhoid first attacked dairyman and then spread to a large number of his customers. His well was found to be extensively contaminated with sewage.
1872	Abingdon.			Dr. Thorne.	Water supply mostly from surface wells in porous soil soaked with excremental and other filth. Sewerage defective. Subsoil in part water-logged. Privy and water-closet nuisances. Accumulations of excrement. "Enteric fever and diarrhœa."

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1872	Burton-Latimer. (Northampton.)			Dr. Thorne.	"Typhoid epidemic." Water supply obtained from wells polluted by soakage from privies and cesspools. Sewerage and drainage defective. Accumulations of excrement and refuse. Nuisance from piggeries. Overcrowding.
1872	Huddersfield.			Dr. Buchanan.	"Typhoid epidemic." Sewers defective. Certain water supplies largely polluted with sewage.
1872	Leigh. (Lancashire.)			Mr. Power.	Privy accommodation insufficient. Polluted water used from wells close to drains, privies, and middens. Accumulations of excrement. Imperfect sewers. Badly constructed and arranged houses.
1872	Olney. (Bucks.)			Dr. Thorne.	"Constant prevalence of enteric fever." Imperfect drainage. Soil round wells sodden with soakage from privies. Cottages without privies or ash-pits. Accumulation of excrement.
1872	Swinton. (Yorks.)			Dr. Ballard.	"Enteric fever endemic." Soakage of excremental filth into wells. Accumulation of excrement and filth.
1872	Wellington. (Somerset.)			Dr. Blaxall.	Water liable to pollution. Imperfect sewerage and drainage. No system for removal of refuse. Nuisances from manure, pigsties, and slaughter-houses.
1872	Whitchurch. (Hants.)			Dr. Thorne.	"Enteric fever." Water obtained from wells sunk in porous soil saturated with sewage. No proper sewerage system. Nuisance from piggeries.
1872	Wincanton. (Somerset.)				"Continued prevalence of enteric fever." Foul privies and drains. Air and soil polluted by sewage. Cesspits. Water supply from reservoir polluted.
1873	Brecknock.			Dr. Harries.	"Enteric fever." Defective drainage. Cesspits leaky and rarely emptied: pollution of soil water. Badly-constructed privies. Nuisances from animals, and from accumulations of manure.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1873	Littleport.			Dr. Thorne.	"Typhoid fever endemic." Water supply insufficient and in part polluted. Nuisances from cesspools, privies, and imperfect drainage. Accumulations of excrement.
1873	Tottenham.			Mr. Radcliffe.	Ill-designed cesspools in parts not sewered. Water supply contaminated with decaying animal refuse. Water-courses and ditches used as sewers. Large deposit of sewage mud at sewage works. Effusion of sewage on lower parts of village due to a flood. Escape of sewer air into the houses on the higher levels.
1873	Moseley and Balsall Heath.	96.	10.	Dr. Ballard.	Porous soil extensively polluted by soakage from dumb wells, bad drains, and ash-pit privies. Wells supplying water for domestic use polluted with sewage or excremental matters. Typhoid fever broke out at a dairyman's; fever evacuations were here thrown into the privy; by soakage, excrement from this privy polluted two wells. Thence infection was borne *via* the milk to the customers. "Suds" in which infected clothing had been washed, afterwards polluted well-water, from the use of which fresh outbreaks were traced.
1873	Marylebone.	244.	26.	Mr. Radcliffe and Mr. Power.	Due to infected milk supply, obtained from a farm near Chilton. The owner of this farm died of typhoid fever, his evacuations being buried, without disinfection, where they found their way into well-water used for dairy purposes. Defects in sewerage and drainage were also discovered in the affected houses.
1873	Combrooke. (Warwickshire.)			Dr. Ballard.	Typhoid imported from Leamington, and spread to adjoining houses. The water much used in these houses was obtained from a well exposed to pollution. Privies in village imperfectly constructed.
1873	Caius College. (Cambridge.)	15 (12 being in Tree Court).		Dr. Buchanan.	Excremental contamination of a particular section of the college water service.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1873	Guisborough. (Yorks.)			Dr. Harries.	"Serious prevalence of typhoid." Water polluted from privy and refuse nuisances. Imperfect scavenging. Ill-built and overcrowded houses.
1874	Baldock. (Herts.)			Dr. Thorne.	"Outbreak of enteric fever." Polluted water. Air fouled by sewer emanations. Water-closets without means of flushing. Accumulations of house refuse. Overcrowding.
1874	Chippenham. (Wilts.)			Dr. Blaxall.	"Typhoid epidemic." Water supply inadequate and polluted. Numerous and very offensive cesspits. Sewers and drains leaky. Refuse heaps and pig-sties near to dwellings.
1874	Godalming.			Mr. Power.	"Constant prevalence of enteric fever." Wells close to cess-pools. Imperfect sewerage. Excremental accumulations.
1874	Truro.			Dr. Blaxall.	"Outbreak of typhoid." Entrance of foul air from sewers into dwellings. Water supply exposed to pollution. Defective sewerage. Insufficient privy accommodation and scavenging. Trade and pig-stye nuisances.
1875	Chatteris. (Cambridge.)			Mr. Radcliffe.	"High rate of mortality from fever." Privy-pits in a porous soil and not water-tight. Wells often close to privy-pits, from which there is soakage into soil.
1874	Auckland. (Durham.)			Dr. Thorne.	"Extensive prevalence of enteric fever." Polluted water. Imperfect sewerage and drainage. Insufficient privy accommodation. Filth nuisances. Overcrowding.
1874	Bourton-on-the-Water. (Gloucester.)			Dr. Ballard.	Polluted water-supply. Defective drainage. Privy nuisances.
1874	Lewes. (Sussex.)			Dr. Thorne.	Large epidemic of typhoid; due in first instance to pollution of town water-supply by water drawn from the Ouse, which receives the town sewage, and spread by suction of polluting matter into the water-pipes of an intermittent water service.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1874	Over-Darwen. (Lancashire.)			Dr. Stevens.	Large typhoid epidemic. Public water-supply polluted by soakage from drain, into which excreta from enteric fever patient had passed, and in various other ways. River extensively polluted. Houses polluted by soakage from privies and cesspools. Gross neglect of scavenging. Accumulations of excrement. Sewerage system defective.
1874	Lower Gornal. (Staffordshire.)	700.	39.	Dr. Ballard.	"Severe outbreak of enteric fever." Absence of drainage. Accumulations of excrement. Foul privies and surface nuisances everywhere. Polluted wells, with sewage containing the specific contagium and excremental matter. Unwholesome cottages.
1875	Croydon (Parish of)	1,200.	90.	Dr. Buchanan.	Escape of infected air from sewers, and its inhalation by persons susceptible of the disease. The air of sewers was "laid on" to houses. No evidence of the well-water having been a vehicle of infection. Opportunities exist for the passage of infection from sewers into small confined cisterns and water pipes, but water pollution played a much less considerable part than sewer air infection in this epidemic.
1875	Northampton Lunatic Asylum			Dr. Buchanan.	"Extensive outbreak of typhoid." Its extension due apparently to the defective state of the drains of the asylum.
1875	Royton (Lancashire.)			Dr. Stevens.	System of sewerage defective. Privies dilapidated and overfull. Soil and air polluted by overflowing cesspools. No system of scavenging. Enormous masses of excrement deposited in the neighbourhood by the Carbon Fertilising Company. Overcrowding.
1876	Chalvey. (Bucks.)			Mr. Power.	Cesspools and wells intermingled in porous soil. Hand-flushed closets, sinks, and stop-drains in connexion with cesspools. Excremental fouling of air, earth, and water.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1876	Eagley and Bolton.			Mr. Power.	Simultaneous outbursts of enteric fever in Eagley and Bolton, in connection with the milk service of a particular dairy. Dairy water obtained from a brook, the course and banks of which had recently been largely fouled by human excrement. Sewerage, drainage, and water-supply arrangements deficient.
1876	Great Coggeshall. (Essex.)			Dr. Thorne.	Epidemic of typhoid spread in first instance through the agency of an infected milk supply, and subsequently through the generally defective sanitary arrangements of the town.
1876	Llanelly. (Brecon.)			Dr. Blaxall.	"Continued prevalence of typhoid. Epidemic of typhoid at Darenvellin." Insufficient privy accommodation. Absence of sewerage and drainage. Accumulation of refuse near dwellings. Water supplies generally exposed to contamination. Unwholesome method of excrement removal.
1876	Royston Rural Sanitary Dist.			Dr. Thorne.	"Large mortality from enteric fever." Water supply in many villages very deficient and very foul. Ill-constructed and ill-managed closets. Sewerage and drainage, when present, sources of nuisance. Dwelling accommodation dilapidated and filthy.
1876	Tideswell. (Derbyshire.)			Dr. Thorne.	"Outbreak of typhoid." Spread of disease favoured by conditions in an intermitting water surface allowing suction of foul air into water-pipes. Sewerage defective. Closet accommodation insufficient and a nuisance.
1877 (1873-77)	Ascot.	69.	2.	Dr. Ballard.	Epidemic of enteric fever lasting, with occasional intermissions, for $4\frac{1}{2}$ years. Found to have invaded, almost exclusively, families supplied with milk from one particular dairy-farm, and to have spread mainly by the use of that milk. Drainage arrangements at dairy bad. Water used for cleaning milk-cans, and for other dairy purposes, inevitably polluted by emanations from drains, which also polluted the atmosphere of the dairy. Well-water contaminated from cesspool privies, dung-heap, &c. Specific infection of milk was also possible.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1877	Bedale. (Yorks.)			Mr. Power.	Outbreak of enteric fever following importation to the town of a case of that disease. Wells generally liable to pollution. Nuisances from midden privies, and from keeping of animals. Deficient drainage.
1877	Bradford. (Wilts.)			Dr. Thorne.	Epidemic due to use of water subject to constant risk of excremental pollution. Nuisance from common privies. Absence of means of drainage in one part of the town.
1877	Padstow. (Cornwall.)			Dr. Blaxall.	Specifically infected sewer air. Excremental accumulation and defective arrangements for its removal. Insufficient water-supply, and wells exposed to contamination. Dwellings dilapidated and unwholesome. Sewers insufficiently ventilated.
1878 (Date of inspection: see under col. vi. for dates of epidemics).	Dewsbury District.			Dr. Thorne.	"Epidemic of typhoid in first quarter of 1877." Midden privies a source of great nuisance. Urine stored about houses for trade purposes. Water-supply subject to pollution; supply intermittent and liable to be fouled by suction of filth into mains. Sewerage and drainage deficient. Water-supply in some cases from polluted wells.
	Gomersal. (In Dewsbury District.)				"Extensive epidemic of typhoid in 1873." Wells liable to pollution. Sewerage defective. Foul air passing from sewers into houses. Disposal of excrement and refuse very faulty.
	Thornhill. (In Dewsbury District.)				"Large mortality from typhoid." Defective and polluted water-supply. Sewerage and drainage facilitating escape of foul air into dwellings. Grave nuisance from excrement disposal.
	Soothill-Nether.				"Very large mortality from typhoid." Causes as described under "Thornhill."

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1879	Chichester.			Dr. Airy.	"Outbreak of enteric fever." Due to infected milk (no contamination traced unless it were in the use of water taken from polluted stream for washing the cows' udders). Drainage mostly into cesspools, often very near drinking-wells. Branch of stream receiving sewage foul and stagnant.
1879	Newquay. (Cornwall.)			Dr. Ballard.	"Serious outbreak of typhoid." Faults of drainage. Use of well-water polluted with sewage. Prevalence of nuisances.
1879	Redhill and Caterham. (Surrey.)	352.	21.	Dr. Thorne.	Epidemic limited to the consumers of the Caterham Waterworks Company's water. This water was contaminated by means of the evacuations of a man employed in the construction of an adit between two of the Company's deep wells, whilst suffering from an attack of unrecognised typhoid fever.
1879	Selborne. (Hants.)			Dr. Blaxall.	"Outbreak of enteric fever," spread by polluted water and infected privies from an imported case of typhoid. Water supply from wells liable to pollution. Filthy privies. Excremental accumulations.
1879	Wing. (Bedfordshire.)			Dr. Blaxall.	Epidemic of typhoid in a circumscribed area associated with the use of water from a well polluted by soakage from privies and drains. Excremental nuisances generally prevalent.
1880	Aveley. (Essex.)			Mr. Spear.	"Outbreak of typhoid." Spread of fever due to sewage nuisances and polluted well-water. Drainage entirely by cesspits, often in close proximity to houses. Well-water exposed to excremental pollution. Scavenging neglected.
1880	Blaby Sanitary District. (Leicestersh.)			Dr. Blaxall.	"Numerous outbreaks of typhoid." Due to drinking water from wells specifically polluted by soakings from infected privies. Also spread by infected atmosphere of privies and by milk. Accumulations of midden privy excrement. Wells exposed to pollution. Drainage either absent or defective.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1880	Haverfordwest. (Pembrokesh.)			Dr. Parsons.	Origin of epidemic uncertain, but disease spread by sewer exhalations and polluted water. Sewers and drains faulty. Drain atmosphere escaping into houses. Ill-contrived water-closets indoors; offensive midden-steads close to houses. Excrement accumulation. Public water-supply liable to contamination by sewer air. Water also obtained from polluted wells and streams. Nuisances from slaughter-houses and pig keeping. Overcrowding.
1880	Melton-Mowbray. (Leicestersh.)			Dr. Blaxall.	Due to infected sewer air. Unwholesome privies discharging into large and uncovered cesspits. Water supply from wells exposed to pollution. Nuisance from pig-sties, slaughter-houses and refuse accumulations. Sewers defective and badly ventilated.
1880	Millbrook. (Cornwall.)			Dr. Ballard.	Epidemic due partly to infected sewers, partly to polluted water supply, and partly to contaminated milk supply from a house invaded by the fever. Entrance of sewer air into wells. Public and private wells polluted by excremental soakage.
1880	Newlyn-East. (Cornwall.)			Dr. Ballard.	"A sudden, extensive and fatal outbreak of enteric fever in an utterly neglected and filthy mining village." Water supply scanty and mainly from a well with which the village drain freely communicates. Epidemic partly due to use of the well water, partly to privies and collections of filth subsequently infected, and partly to distribution of milk from infected houses.
1880	Pemberton and Orrell. (Lancashire.)			Dr. Airy.	Extensive outbreak of typhoid during drought after heavy rain, probably due to polluted spring water. Water supply from rain-water butts, or from springs and surface wells exposed to pollution.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1880	Southend. (Essex.)			Dr. Thorne.	Considerable epidemic of typhoid at Prittlewell, due to use of polluted water supply. Great want of drainage, and aggravated nuisances from cesspit privies in the village. At Southend, drainage incomplete. Sewer ventilation imperfect or absent.
1881	Blackburn.	266 (from January to June).	24 (up to April 16th).	Dr. Airy.	Due to contamination of water-supply by soakage from drain conveying discharges of a fever patient at Guide on line of conduit. Sanitary administration good. Old midden privies being replaced by tub privies and water-closets. Excreta taken by canal to manure works. Sewage utilized for farm irrigation; other refuse destroyed in furnace.
1881	Bodmin Urban Sanitary Dist.			Dr. Parsons.	"Severe epidemic in 1881." Original source not traced. Sewers and drains badly constructed, leaky, and unventilated. Water-supply partly from springs and wells exposed to sewage pollution. Reflux of foul matters from closet into public water-supply possible. Nuisances from surface filth and pig-keeping.
1881	Bridlington.			Dr. Parsons.	"Sudden and extensive outbreak of typhoid." Especially affected houses supplied with milk from a particular dairy. Dairy well-water polluted and possibly specifically infected. Some localities badly drained, with fever persisting. Nuisances from cesspools, defective house-drains, and foul open water-courses.
1881	Hinckley. (Leicester and Warwick.)			Dr. Airy.	Water from wells in danger of pollution and liable to drought. Nuisances from bad drainage, privies, middens, and pig-sties.
1881	Howden Rural Sanitary Dist. (Yorks.)			Mr. Spear.	"Outbreaks of typhoid in different villages." Water supplies from shallow wells much exposed to excremental pollution. Streams polluted by privy contents. Specific pollution of school-wells followed by outbreaks.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1881	Ilkeston. (Derbyshire.)			Dr. Blaxall.	"Extensive epidemic." Due chiefly to infected sewer air escaping within and about dwellings. Groups of cases referable to infected privies and polluted water. Storage of excrement in large unwholeseme privy-pits. Half the town water supplied by wells sunk in a filth-sodden soil, and from tanks in direct communication with sewers. Deficient drainage.
1881	Tawton. (North Devon.)			Dr. Blaxall.	"Limited epidemic due to specifically contaminated water." Water supply from wells and other sources, both exposed to dangerous pollution. Sewage discharged into watercourse. General excremental nuisance. Privies filthy and dilapidated. Bad drainage.
1881	Tavistock Rural Sanitary District.			Dr. Blaxall.	"Typhoid endemic with occasional severe epidemic outbreaks." Drinking water often exposed to dangerous pollution. Excremental nuisances frequent. Sewerage and drainage defective.
1881	Uckfield.			Mr. Power.	"Outbreak of enteric fever." Wells sunk in soil befouled by soakage from privies, cesspools, ashpits, and drains. Sewers unventilated. House-drains unventilated and in connection with sewers.
1882	Bangor and Bethesda.	548.	42.	Dr. Barry.	The attacks limited to the consumers of water obtained from the Bangor water-works: case of typhoid at Llwyurhandir; excreta from this patient passed into drain, thence to a small stream from which Bangor water-supply is drawn, and thus to the filtering reservoir. Even if the filters could have arrested infective matter, many of the plugs were defective; fully one-third of the water passing unfiltered into the water-main. Cesspit privy at Llwyurhandir is below level of infected drain. Spread of disease promoted by connection between houses and ill-ventilated sewers, and filth accumulation near houses.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1882	Galgate. (Lancashire.)			Dr. Barry.	Outbreak among persons drinking water obtained from a well contaminated with excremental matter. Insufficient water supply. Wells of doubtful purity. Midden privies a source of nuisance.
1882	Millbrook. (Cornwall.)			Dr. Ballard.	Same causes operating as caused the epidemic in 1880 q. v. "Renewed outbreak."
1882	New Shoreham (Sussex.)			Dr. Thorne.	"Prevalence of enteric fever." Water drawn from polluted wells. House drains in communication with public sewers.
1882	Norwood. (Middlesex.)	35.		Mr. Power.	Sudden dissemination of typhoid in fourteen dwellings supplied with water from the same well. Infected cesspool contents were deposited in a hole some 40 feet from the particular well, upon higher ground than, and in the line of natural soakage to, the well. Intervening was a porous gravelly soil.
1882	Southborough.	Twenty-four houses.			Outbreak of typhoid in a circumscribed locality. Drains admitted of contents escaping into surrounding soil, and often of gas discharging into houses. Water entirely from local wells, often in close proximity to drains.
1882	Ebbw Vale Urban District.			Mr. Spear.	"An almost house-to-house prevalence of typhoid in small detached hamlet in 1881." Due to excremental pollution of atmosphere from privy and other nuisances. Public water supply had failed, and inhabitants had largely resorted to questionable sources. Prevalence of sewage nuisances.
1882	Clapham. (Surrey.)			Dr. Parsons.	"Outbreak of typhoid fever." Attacked (with one exception) only persons getting milk from a particular dealer at Clapham. Mode of milk infection unascertained, but there had been cases of fever some months before in the place (Axminster), whence it came, and the well water at the two milk farms there concerned was contaminated with sewage products.

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1882	Dartford Registration District.			Mr. Spear.	"Prevalence of enteric fever." In parts invaded the sub-soil water stands 3 or 4 ft. only from the surface, and into this water-level wells and cesspools are sunk indifferently. In the part of the town attacked, 40 per cent. of houses were supplied from local wells, and in these houses 80 per cent. of the fever attacks occurred. Cesspool and other nuisances very common.
1882	Ulverston. (Lancashire.)			Mr. Spear.	Considerable prevalence of typhoid in the Autumn of 1881. Water mains water often so turbid that inhabitants resort to local supplies. Outbreak confined to users of a certain one of these local supplies. Insufficient sewer ventilation.
1883	Hitchin. (Herts.)	100 (about).	7.	Mr. Power.	Public water supply liable to pollution by reflux of water from the river Hiz to the reservoir and pumping well. The river receives refuse water and sewage; and "it is impossible not to admit that, in all probability, there has been direct relation between the circumstances of pollution on the 30th December, 1882, of the public water service, and the outburst of fever in mid-January." Defects of public sewerage and private drainage.
1884	Beverley.	231.	12.	Dr. Page.	Water supply chiefly from borings into the chalk which are occasionally polluted by direct percolation from a sewage-polluted soil. Water on analysis found highly charged with sewage matter. Sewerage antiquated and bad. Sewers unventilated, and having catch-pits at intervals to retain solids. Cesspools compulsory where water closets are in use, being made in the course of the house-drain before this latter enters the public sewer—the sewer thus receiving only the putrid out-flow of the cesspool. Privy middens of large size uncovered, often connected with drains, and sunk below the surface level. Main feature of outbreak was specifically contaminated general water supply of Waterworks Company, derived from deep well in chalk. Company's well and

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1884	Beverley (*Con.*).	231.	12.	Dr. Page.	reservoir close to sewage-irrigated field belonging to East Riding County Lunatic Asylum, in which cases of typhoid had occurred antecedent to outbreak in Beverley. The outfall of the Asylum drains is into a settling tank in the corner of a 7-acre field next to the Water Company's premises. Once a fortnight the settling tank is emptied by an intervening drain into an adjacent cesspit—this being simply an excavation in the clayey soil. It was not proved that soakage could occur from the cesspit to the well. Experiments negatived its possibility. Frequent chemical analyses of the Company's water during the epidemic repeatedly proved its purity and fitness for domestic use. Thus, the method of contamination was probably the broad irrigation practised on the field.
1884	Colne. (Lancashire.)			Dr. Airy.	"Sharp epidemic of typhoid." Origin undiscovered. Drainage very bad. Sink pipes in untrapped connection with drains. Nuisances from ash-pits, refuse heaps, and cow-sheds. Pollution of river Colne. Water supply fairly pure.
1884	Kidderminster.			Dr. Parsons.	"Extensive outbreak of typhoid over the whole town." Public water supply in large part derived from an artesian well in dangerous proximity to sewage-pumping station. Intermittent water service—hence possibility of accidental contamination of water by foul matters sucked into pipes during intermissions. Arrangement of sewers favours the distribution of infected sewer air. House drains badly trapped, unventilated, and often in connexion with interior of houses. Bad scavenging. Refuse accumulations: offensive trades. Outbreak owing either to inhalation of spray from sewage-polluted river water, or to drinking water of a well contaminated by soakage from the same.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1884	Romford Dist.			Dr. Parsons.	Outbreaks of typhoid at Dagenham, due to drinking polluted well water, and to effluvia from foul ditch, in 1883 and 1884. At Ilford in 1882—3, due to infected milk supply, and subsequently spread by sewage effluvia from cesspools and defective drains.
1884	St. Albans.	January 2. February 2. March 4. April 0. May 93. June 38. Total for May and June, 131.	23 (during May, June, and July).	Mr. Murphy.	"Simultaneous outbreak of typhoid fever during June and July at St. Albans and London among the consumers of milk coming from a farm near St. Albans." Absence of evidence that the milk at the farm had become infected in any of the commonly-believed ways. Some reason for believing that this farm milk which had given rise to a serious outbreak of typhoid in St. Pancras in 1883, had retained, though to a slight degree, power of infecting its customers in the interval between the two outbreaks.
1884	York.	315.	54.	Dr. Airy.	Not due to water contamination. Milk supply exculpated. The outbreak was apparently due to exhalations from the sewers after an exceptionally dry hot summer. Sewers unventilated; their outfalls covered by, and admitting backflow from, the River Ouse. Sink pipes generally disconnected from the drains.
1885	Faldingworth and Barlings. (Lincolnsh.)			Dr. Greswell.	Faldingworth: small outbreak of typhoid traceable to pump-well water polluted by washings from a fever case imported from Newark. Filthy ditch sewers. Barlings: outbreak of typhoid traceable to pollution of the village water-supply by sewage. House drainage defective. Vault closets in dangerous proximity to dwellings. Chief supply of water obtained by imperfect filtering of the sewage-polluted village brook.

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1885	Hebden Bridge			Dr. Greswell.	Outbreak of typhoid, affecting chiefly cottagers using excrementally polluted water from the "Birchcliffe stone cisterns." Bad house drainage. Old open middens in dangerous relation to dwellings and open water-courses. Springs used for domestic purposes in almost all cases open to pollution.
1885	Kidderminster.	35 (in second half of 1885).		Dr. Parsons.	Cases existing in places where defective house drains existed—*vide* 1884.
1885	Lower Sheringham. (Norfolk.)			Dr. Airy.	Severe outbreak of typhoid under circumstances pointing to contamination of milk supply. Origin of infection uncertain. Water supply from land drainage and rivulet in danger of pollution. Drainage defective. Nuisances from privy-pits, net tanning, whelk boiling, and from ponded sewage, ordure, and fish offal.
1885	Market Weighton. (Yorks.)			Mr. Royle.	"Prevalence of enteric fever." Due to drinking water from surface wells in a porous soil, contaminated by soakage from defective sewers, cesspools, &c. Accumulations of excrement.
1885	Newark.			Dr. Parsons.	"Typhoid prevalent in 1884." An old and closely-built town. Sewers mostly unventilated. Sewage discharged unpurified into the Trent. Company's water-supply derived from gravel bed in neighbourhood of this river. Shallow wells also in use liable to contamination. House drains with loose iron traps, permitting escape of drain air into and near houses. Offensive midden privies. Refuse accumulations.
1886	Swanage. (Dorset.)			Mr. Harvey.	"Outbreak of enteric fever." First case in January; assumed an epidemic form from July to September. Water-supply largely from impure wells. Drainage system consists almost entirely of square rubble sewers, many of them joining a highly-polluted and almost stagnant brook. Large uncemented

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1886	Swanage(*Con.*).			Mr. Harvey.	privy pits on and in permeable sedimentary rocks dipping steeply towards the town. No public scavenging beyond street-sweeping. The epidemic associated at its commencement with the use of milk from a dairy situated on the polluted brook and without water-supply on the premises.
1887	Eastry Rural Sanitary Dist. (Kent.)			Mr. Spear.	"Mortality from typhoid 16 per cent. higher than elsewhere in England and Wales." Water supplies of most of the villages subject to pollution. Cesspits and privy-pits in close proximity to dwellings and wells, polluting both air and water. No proper means of sewerage. Refuse and excrement accumulations.
1887	Margate.			Dr. Page.	"Increasing mortality from enteric fever." Deposit of sewage and excrement in deep cesspools and cesspits sunk into the chalk. Pollution of air and soil by excremental accumulations. Water supply pumped from a well in the chalk, beside a populous neighbourhood. Water of bad quality and exposed to contamination by soakage of sea-water and from cesspools. Water-closets getting water directly from mains.
1887	Mountain Ash. (Glamorgansh.)	518.		Mr. Spear.	"A sudden and severe epidemic of typhoid, 518 cases occurring between July and October, 1887." The specific poison was distributed by water delivered through one particular water-main. Of the 396 houses supplied from this main below a certain point of its course 57 per cent. were invaded by fever. Near this point (where evidence of specific contamination commenced) defects in the main were discovered, which would lead during intermissions of water supply to insuction of air, and probably of liquid, from old drains. Earlier history shows that since the water-main in question was laid in 1855, an endemic prevalence of typhoid has

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1887	Mountain Ash (*Con.*).	518.		Mr. Spear.	existed in the district supplied by it. Analysis of the water showed that a sample taken before the nightly intermission of service was pure; that taken from the same tap after intermission gave evidence of animal contamination and of the appearance of low forms of life. Sanitary conditions in other respects fair.
1888	Buckingham.			Dr. Parsons.	A sudden outbreak of typhoid in January and February, confined at first to a poor suburb of the town, and especially affecting persons drinking water from a particular "spout," the water conduit to this spout exposed to pollution from a leaky drain which had received specifically infected excreta from a previous case of typhoid. Scattered cases later on referable probably to infection derived from defective drains and foul closets. Water generally from wells exposed to risk of pollution by leakage from cesspools, drains, &c. Sewers and house drains very defective, allowing deposit, leakage, and entrance of drain air to houses. Old privies with large deep vaults: foul hopper closets.
1888	Flint.			Mr. Spear.	Fourteen cases of typhoid fever in seven houses, between August 11th and 20th: subsequently general over the town. Water supply intermittent and discoloured when turned on in the morning. Method of excrement disposal in infected locality such as to cause fæcal fouling of air and soil.
1888	Keynsham Rural Sanitary District. (Somerset and Gloucester.)			Dr. Blaxall.	"Recurring prevalence of epidemic typhoid." Conveyed in the bodies of persons attacked from one part of district to another. Spread of the disease by specific excremental pollution of water. No proper sewerage provision. Cesspit privies in vogue. Water-supplies exposed to dangerous pollution.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1887 and 1888	Mytholmroyd. (Yorks.) …………………	(1887) 66. (1888) 29. Total 95.	10. 5. 15.	Dr. Page.	Prevalence of unwholesome conditions of water-supply, drainage, and excrement disposal. River Calder highly polluted with sewage and excremental matters, in fact little better than an open sewer. Twenty-two of the fifty-five houses attacked are situated in the immediate vicinity of this river, inhaling the effluvia arising therefrom. The local sources of water-supply are from small streams descending the hill-side. Washings from meadows and manured lands, and excremental filth pollute these streams. The water is conveyed in pipes from a spring on the hill-side. This spring water is reinforced by sewage from a manure heap. No system of sewerage exists. Bad scavenging. Midden privies flowing over, &c.
1887-8	New Brighton. (Cheshire.)	21 (during 1887-8.)		Mr. Spear.	"Typhoid fever prevalent." The fever prevalence had no relation to the water supply, nor to the milk supply. Faulty sewer ventilation. Drains are commonly carried beneath the floors of dwellings, without any special precautions. Gullies having unbroken communication with the drain, and so with the sewer, often exist in cellars. "The appearance of typhoid, at New Brighton has been found so constantly associated with specially grave defects of drainage, as to create a strong suspicion that this condition has been the cause of the mischief."
1887-8	*New Clee and °Gt. Grimsby.	*120. °140. Total 260.	*21. °31. Total 52.	Dr. Page.	General water supply good. Some of the households drew their water supply from local wells, which were subject to risk of specific contamination. Some cases were due to the use of a box privy, into which the infected discharges of an earlier case had been thrown. More frequently, however, such discharges were thrown into the yard drain-inlets and catch-pits, and so infection of some of the smaller and defective drains occurred. Unventilated public sewers, along with faults of private drainage, led to ventilation of sewer air into private dwellings. "The pollution of wells by excremental matters must be considered to have played a part in the epidemic."

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1888	Stourbridge Rural Sanitary District. (Staffordshire.)			Dr. Parsons.	"A severe outbreak of enteric fever in third quarter of 1888 in Pensnett and Bromley." Affected specially young adult males employed at ironworks, their chief beverage being ginger beer, made often at home from the water of polluted wells not wholly boiled. No sewerage; slop-water nuisances prevalent; privies with wet open ash-pits; pig-keeping nuisances; wells exposed to pollution from these sources.
1888	Standish-with-Langtree. (Lancashire.)			Dr. Page.	"Prevalence of enteric fever." Ventilation of sewers obstructed. Midden privies drained into sewers causing nuisance. Water-supply from local sources, one of them exposed to excremental pollution; incidence of fever chiefly in families using this supply, but spread of disease due also to privy defects. No system of scavenging. Prevalence of nuisances from undrained yards and from pig-keeping.

Sir Douglas Galton (London), in proposing a vote of thanks to Dr. Poore for his valuable paper, remarked that, as an engineer, he could not at all agree that the point of getting rid of refuse matter was not an engineering question. The engineer, he held, had a distinct influence upon every part of science if he manipulated and completed the work which the chemist, the geologist, and all other heads of science began. For this reason therefore he maintained that the matters to which Dr. Poore had referred were entirely engineering questions. With respect to the argument about the living earth he held that water was as great a purifier as the earth, and reminded his audience in this connection that if refuse was turned into a stream, and they went some few miles down the stream, they would find that every trace of the refuse had vanished, having been taken up either by minute animals or plants, or consumed for food by fishes. A report recently issued on the disposal of the sewerage of Paris distinctly bore out this argument, the document tracing out the processes of purification throughout the entire length of the river's course. With regard to the argument about the waste of throwing sewage into the Thames, one of the ablest persons who had to do with agricultural and sewage questions (Sir John Lawes) had, in giving evidence before the Royal Commission, called attention to the fact that the quantity of fish taken on the eastern coast of England far and far exceeded that taken on the western, and he raised the question whether it was not that the extra food which was provided by the sewage of London was not mainly the cause of this. With respect to the question of water carriage he was quite in favour of this course being taken in country districts, but he gave the following statistics to show that in towns the water-closet system was certainly the more healthy. In Brighton, for example, where water-closets are everywhere used, the death-rate was only 15 per thousand, the percentage rising in Bolton, where the refuse was carried away, to 22 per thousand. He considered, too, the modern methods in sanitation were in a great degree responsible for the diminution of fever cases. In 1868 the death-rate from fever was 78, in 1878 it was reduced to 37, in 1888 to 17, and last year this had still further been reduced to 14. With the few exceptions he had ventured to take he considered Dr. Poore's address most charming and comprehensive; and, in conclusion, he could pay no higher compliment to it than in saying that it was eminently worthy of Dr. Poore.

Mr. A. G. Henriques, J.P. (Brighton), who seconded the vote of thanks, mentioned that the rivers of Sussex had suffered much from pollution. As chairman of the River Pollution Prevention Committee of the East Sussex County Council, this fact had been brought prominently under his notice. He had himself seen beautiful streams absolutely polluted and destroyed as useful drinking water by the sewage of trifling villages, without any disguise or concealment, being drained into them. This system of pollution, he found, had been going on for years. With regard to another point of

Dr. Poore's address, he mentioned that he should be sorry to see the disestablishment of engineers and men who carried out the execution of sanitary problems. It might be true that they had put too much faith in water, but they in towns could hardly afford the time to substitute for water anything that Dr. Poore had suggested, and until some other and better means than had yet been suggested were found, he thought it would be a long time before their engineers gave up the use of water in cleansing towns and giving health to cities.

Dr. Poore (London), in reply, admitted that, so far as they went, the criticisms were just, but he reiterated the statement contained in his address that his remarks were directed almost solely to country districts. Mr. Henriques had told them something of the streams in Sussex being filthy, and his (Dr. Poore's) advice was, "Go to the cottagers, and make them do their duty." It was imperatively necessary that every village, however small, should have its sanitary arrangements carefully directed, for out of the small villages of to-day would come, in many cases, the great towns of the future. With regard to his remarks about the engineers, he of course meant nothing unkindly. Her engineers, there could be no doubt, were England's greatest glory. But the engineer was in the position of Hercules, for the king to-day was Augeas—and his remarks were addressed to Augeas—who, if he did not keep his property in a satisfactory sanitary manner, would be obliged to get Hercules to show him the way. He had every admiration for Hercules, but his counsel must be taken as addressed to Augeas!

On "Some Points in relation to Septic and Infectious Diseases," by James Turton, M.R.C.S.E., &c., Chairman of the Sanitary Committee, Brighton Town Council.

The subject of those diseases which owe their origin or their propagation to insanitary conditions, is one of overwhelming interest to all those who are engaged in the study or practice of State Medicine, in fact, one might say, that in itself it embraces, directly or indirectly, almost the entire range of sanitary science; that being so, it forms some excuse for me in bringing forward a few remarks on some points which seem to me to be of particular interest.

In the first instance, I will prepose that any insanitary condition which leads to the contamination with organic matter, of air food or drink, may of itself be the cause of disease, or, on the other hand, may be the means of conveying the germs derived from pre-existing cases of disease; for example, a water supply which has become contaminated with sewage, may, in the individuals drinking it, give rise to symptoms, such as fever,

sickness, and diarrhœa, which are of a more or less indefinite nature, and which cease as soon as, or shortly after, their cause is removed; or may convey the germs of a definite disease, such as typhoid fever, which runs a certain course, even after the removal of the insanitary condition which enabled it to spread.

Dr. Marston, of the Medical Staff, gives a striking illustration of the simultaneous occurrence of these results, in his paper on the Fever of Malta, published in the Army Medical Reports for 1861, wherein he states that when enteric fever broke out at the Fort of Lascaris, from the opening of a drain, other affections were simultaneously developed, viz., diarrhœa, dysentery, slight pyrexial disorders, and diseases of the primary assimilative organs.

It is obvious therefore, that here we have two distinct results which may reasonably be attributed to distinct causes.

The one is of a simple or septic nature, and the other of a specific or infective character, and it is to the former of these conditions that I wish particularly to draw attention in my remarks.

Cases of septic poisoning resulting from sanitary defects are familiar enough to all those who are engaged in the practice of either preventive or curative medicine; and although they present a great variety in the grouping and the violence of the symptoms, they all show a more or less strong family likeness; the symptoms most commonly present being general malaise, fever, sore throat, sickness and diarrhœa.

They usually result either from the contamination of inspired air by sewer gas, emanations from leaky drains, cesspools or other foul accumulations, or from an impure water-supply; and, generally speaking, when the poison is conveyed by the air, the throat symptoms are predominant; when the water is at fault, the gastric troubles are uppermost. Obviously the tissues or organs brought chiefly into contact with the morbid agents suffer the most, at any rate that has been my experience; but the sickness and diarrhœa so commonly present in these cases may also be regarded as efforts of nature to eliminate the poison. A patient of mine discovered that the water-bottle in her bedroom was being filled with water from the cistern supplying the water-closets, from the fact that it made her sick each time she drank from it, and in all probability the prompt rejection by the stomach of the offending fluid prevented any further ill-consequences.

But the point I wish specially to draw attention to is the *etiology* of these conditions: What is the cause of the symptoms, and wherein does it differ from the cause of zymotic disease, in which we recognize the operation of a distinct virus?

The answer to this question must of necessity be of a speculative nature, and I do not profess to bring forward anything more than mere general conclusions based upon analogous conditions.

I may here mention that in Parkes' Practical Hygiene it is stated, that some years ago Dr. Herbert Barker submitted the question to experiment by conducting the air of a cesspool into a box containing animals. The air contained carbon dioxide, hydrogen sulphide, and ammonium sulphide, but the presence of organic vapours was apparently not sought for in the analysis. Three dogs and a mouse were experimented on. The three dogs were confined in the box, they all suffered from vomiting, purging, and a febrile condition, which, Dr. Barker says, "resembled the milder forms of continued fever, common to the dirty and ill-ventilated homes of the lower classes of the community."

Dr. Barker attributed the results, not to the organic matter, but to the mixture of the three gases, particularly the latter two.

I believe the condition in these cases to be one of septic intoxication, due to the entrance into the system of the products of putrefaction, and that it is directly analogous to the surgical fever which sometimes follows the infliction of wounds, and which in pre-Listerian days was infinitely more common than it is at the present time; in the former case the products of putrefaction enter the body through the natural channels of the respiratory and alimentary tracts; in the latter, through the blood-vessels and lymphatics leading from the wound.

I say products of putrefaction, because I think that in the present state of our knowledge, it is unsafe to attempt to specify any particular poison or poisons, and such products as are already known are very numerous; speaking generally, however, one may say that the organic compounds known as ptomaines, are more poisonous than the simpler chemical compounds, such as the sulphides.

In this connexion the following extract from Billroth's work on Surgical Pathology is of interest:—

"Of late, many attempts have been made to determine what substance in decomposing animal tissues is the true poisonous principle, and for this purpose putrid fluids have been treated chemically, till some one body should be found which in the smallest dose should excite the symptoms of septic poisoning. Thus, Bergmann has produced a body of this nature from decomposing yeast, which he calls sepsin. To prove that this body *alone* (whose presence Fischer could not prove in decomposing serum or pus) is the poison, it would be necessary to prove the innocuousness of all other bodies chemically formed

during putrefaction. But this cannot be done; sulphuretted hydrogen, sulphuret of ammonium, butyric acid, leucin, and some other substances formed during the putrefaction of organic bodies, also act as septic poisons when injected into the blood; so that I cannot enter into the laborious search for one body in the putrid fluids which shall bear all the blame of the injurious effects. It is very probable that in decomposing fluids according to their qualities, degree of concentration, temperature, &c., very many different poisonous substances may form, which I further imagine as going on changing, till they reach some final terminal stage."

Amid so much that is uncertain it is however clear, that the morbid agents in the class of disease we are considering, are capable both of suspension in the air and of suspension or solution in water.

It must be remembered that in house drains, which are the chief offenders, are present in a peculiar degree all the conditions essential to putrefactive changes; there are the putrescible matters, the water, oxygen, and micro-organisms, while the excreta themselves supply the necessary temperature. But healthy excreta cannot be regarded as possessing any peculiar poisonous property apart from their putrescibility, for it is well known that the introduction into the body of the products of putrefaction of other organic matters produce similar results, and I would instance the following:—

(I.) The dissecting-room sore throat common among medical students.

(II.) The well-known evil effects of a water-supply contaminated by soakage from burial grounds.

(III.) The effects of effluvia from decomposing animals; an instance of this is recorded by Parkes as occurring in the French camp before Sebastopol.

(IV.) The effects of a water-supply containing decomposing vegetable matter.

(V.) The results of inhaling the products of putrefying vegetable matters; as an instance of this I quote the following from Parkes' Practical Hygiene:—

"Occasionally, outbreaks of disease occur from impurities of the atmosphere, the nature of which is not known, though the causes giving rise to them may be obvious. Dr. Majer records the case of a school at Ulm, of sixty or seventy boys, where the greater number were suddenly affected, on a warm day in May, with similar symptoms:—giddiness, headache, nausea, shivering, trembling of the limbs, sometimes fainting. The attack occurred again the next day, and a common cause was certain. The room was enclosed by walls, in a narrow

space, where the snow had lain all the winter; the wall was covered with fungous vegetation and with salts from the mortar. From the sudden entrance of warm weather fermentation had set in, and a strong, marshy smell was produced; the substances, of whatever kind, generated in this way accumulated in the narrow, ill-ventilated space. Removal to a healthier locality at once cured the disease."

And the following cases occurred in my own practice last year. I was called to attend several members of a household suffering from general malaise, headaches, and occasional vomiting. The house drainage was good, but an unpleasant smell was noticed in the kitchen, and the symptoms attacked only the servants and those members of the family who were in the habit of entering the kitchen. I had the flooring taken up, when several of the joists were found to be rotting in places, and emitting the odour complained of. The putrid wood was removed, and a better provision made for ventilating the space beneath the floor. Since then there has been no illness in the house.

Other instances might be mentioned, but I think I have adduced sufficient evidence to show that all collections of putrescent organic matters, of whatever kind, are equally capable of producing symptoms of septic poisoning; although, for very obvious reasons, the putrefaction of sewage is by far the commonest cause.

Although septic and infective conditions are distinct etiologically, yet clinically the dividing line is in some instances a very narrow one; thus, some cases of septic sore throat may very closely resemble diphtheria, and are in fact often styled diphtheritic, although I think this term when so applied a misleading one. But this fact only bears out the analogy I have sought to draw from surgical practice; for there, many cases of septic intoxication occupy the borderland of septicœmia and pyœmia, which latter are generally regarded as diseases of a truly infective type.

Further, I believe that septic intoxication is not infrequently combined with the infective process; if this be so, it may account for some of the atypical cases of the latter which one not seldom meets with in practice. I would suggest that cases of typhoid with sudden onset, or cases of scarlet fever with severe throat symptoms, may possibly bear this interpretation.

Finally, the state of ill-health induced by the introduction into the system of the products of putrefaction, must be regarded as a powerful predisposing cause of infectious disease.

Another point which is worthy of discussion, but to which time will permit me only very briefly to allude, is the question

of the action of the eliminating organs in the various zymotic diseases.

We are accustomed, from clinical experience, to associate certain functions, almost exclusively, with the elimination of the *materies morbi* in the different infectious diseases, *exempli gratia;* the skin and kidneys in scarlet fever, the bowels in typhoid.

Without questioning the fact that in certain diseases, certain organs are the most active, it appears to me very probable that, with a poison so generally disseminated throughout the body as that of the infective diseases, all the eliminating functions are called into action, in a greater or lesser degree, to get rid of the offending material.

And this view is quite consistent with the fact which modern research appears to establish, viz.: that the symptoms in infectious disease are due to the chemical products of the activity of certain specific micro-organisms, and not to the organisms themselves.

I will take, as one instance, scarlet fever; we assume, and in all probability rightly so, that the poison is chiefly eliminated by the skin and kidneys, but the breath is also very infectious in the febrile stage, and although the throat symptoms may account for this, yet we cannot exclude the lungs as a source of infection, in other words we cannot assert that in the febrile stage of scarlet fever, the lungs are not actively engaged in eliminating the poison, and similarly with regard to the bowels.

And with reference to measles, although the pulmonary system is the most active agent in the work of elimination, yet it is a fact that the other organs assist, witness the desquamation which so frequently follows.

I attended a case of severe measles recently, in which diarrhœa was a prominent symptom, and I could not help regarding it as an additional means of eliminating the poison.

Again, with respect to typhoid fever, unquestionably the bowels are the principal means of extruding the poison, but does not the pneumonia, which is such a frequent accompaniment of typhoid, point to increased functional activity on the part of the lungs?

And as it is well recognised that the poison of typhoid may be conveyed in inspired air, there is obviously no physical or chemical reason why it should not be eliminated in the expired air.

These points, although necessarily matters of speculation, have a very practical bearing on the question of the spread of epidemics, and the necessity for the proper isolation of patients, and thorough disinfection of the excreta in all cases of infectious disease.

On "*The Sanitary Advance of Brighton*," *by* Alderman Joseph Ewart, M.D., F.R.C.P. Lond., J.P.

Site—Environs—Climate.

As regards the site on which the town of Brighton stands, it would be difficult to find any locality endowed with so many physical advantages or impaired by so few defects. Of the latter there are none which have not already been, or which cannot be, either mitigated or removed. Thus, whilst there is no part which does not furnish an admirable fall for drainage, the alluvial and marly Steine and Level, to which slight objection has been taken by some authorities, is mainly utilised as open spaces and recreation grounds. There is, it is true, a fringe of houses on each side of this valley, whose foundations may not dip down as far as the chalk, but the populous districts extending to the eastern and western boundaries of the borough, have a basis of chalk approaching within a few inches of the surface. Some parts of West Brighton or Hove, such as Furze Hill, Brunswick and Palmeira Squares, the Stamford and Aldrington Estates are built upon clay; but many of the splendid mansions in the vicinity of the railway stand upon chalk. Owing mainly to a chalk basis—east and west of the Steine, Enclosures, and Level—the climate is comparatively dry and bracing, less so on the alluvial and clay soil just mentioned. But the drainage fall is everywhere so efficient that any defects of soil here and there, especially in Brighton proper, are scarcely appreciable in adversely affecting the public health; whilst in Hove and Aldrington, the influence of the clay is greatly modified or neutralised by well-built houses and wide streets. Still, its existence is on a scale sufficient to impede, to some extent, absolutely free drainage, and, in part, to account for the less bracing character of the air here, particularly in the summer months. Artificial drainage, where required, would remedy, as far as it is possible to do so, these conditions; still more so if coupled with asphalting or cementing the foundations and basement floors of houses. There is no oozy or swampy ground in the immediate vicinity. Add to these signal advantages, the salubrious Downs to the north; the standing forth of the town on chalk cliffs approaching more or less closely the shingle, beach, and sea; a southerly or south-

westerly aspect; an ozone and health-laden prevailing breeze; an unusually large proportion of sunlight, during the season, from October to December inclusive, when the Metropolis and many of our great inland cities and towns are liable to be enveloped in smoke and fog; a moderate mean annual temperature of 49·8 degrees (F. E. Sawyer, F.S.A.); greater coolness in summer, and warmth in autumn and winter than in inland towns; a moderate mean daily range of 11·8 degrees, especially in October, November, December, January, and February, when it only amounts to 10·9, 8·8, 8, 7·7, and 8·3 degrees in these months respectively (*loco. cit.*); a mean barometric pressure of 29·970 inches, a mean degree of humidity of 81, saturation being 100 (*idem*); a rainfall of only 28·35 inches (*idem*); very few days in the year in which exercise may not be taken in the open air in our parks, on our spacious and well-kept pavements and promenades, and you have set forth in brief the leading reasons why the physical climate of Brighton stands deservedly so high, both from a prophylactic and curative point of view.

There is no part of Brighton and its environs not materially influenced by sea air when the breeze blows from the south or south-west, as every part is affected by the atmosphere of the Downs when the current sets in from the north and north-east. The variations of climate are well defined. Thus, along the sea front, a stretch of four miles or more, from Black Rock to Aldrington, a pure marine atmosphere is encountered, modified, in strength and intensity, by temperature, barometric pressure, humidity, rain, wind and the direction of the same, electro-magnetic conditions, sunlight, clouds, fog and smoke, or both. From Black Rock to the Aquarium, owing to the shelter of the cliff from the north wind, the air is so mild and genial in good weather, even in the winter, as to approach that on the shores of the Mediterranean or of the Island of Madeira. Hence, the lower drive and promenade here have been appropriately named, at the suggestion of the late Alderman Lamb, "The Madeira Road." A commodious shelter hall and terrace, approached from the cliff above by means of a hydraulic lift, opened a few months ago, will, it is hoped, add much to its utility and attractions to visitors, residents, and invalids, of this bright, sunny, mild, and health-giving retreat. When the current of air is moving from the south or south-west, the whole of the sea-front from the Aquarium to Aldrington, in fine weather, participates in the mildness of the Madeira Road, but not quite to the same degree. On the cliff protecting the Madeira Road, and to the north of which Marine Parade, Kemp Town, and the Queen's Park are situated, the climate is strong, bracing and exhilarating. The same may be said of the

Montpelier District. The northern parts of the town are permeated by the crisp, dry and pure air coming from the Downs. Generally speaking, the climate is extremely beneficial in the earlier phases of tubercular, and in most forms of pulmonary and bronchial disease, both in adults and children. Conditions, characterised by weak and disordered digestion, poorness of blood, debility, want of nerve-tone, whether resulting from recent illness, occupation intrinsically unhealthy, or employment in insanitary, overcrowded, or ill-ventilated workshops or offices, high pressure, or over-work, are rapidly repaired by the rest, exercise under the best hygienic circumstances, good food, and ozone-charged air available at Brighton. Preston, an outlying suburb and recent acquisition, is singularly favoured. Thoroughly sheltered on the north, east and west by spurs springing from the Downs; enriched by an abundance of the finest trees and well-cultured gardens; ornamented by many handsome villas and mansions; provided with a gem of a park, greatly improved in beauty and attractiveness by a generous development of the art of landscape or pictorial gardening; endowed with a soft and soothing, yet invigorating climate of its own, sometimes modified by the stimulating air wafted from the neighbouring ocean, at other times tempered by the exhilarating air coming from the Downs—it is one of the prettiest, cosiest, and healthiest villages in England.

Arterial Drainage.

The whole of the sewage of Brighton, Preston, and Hove is carried by means of well-constructed sewers into an intercepting sewer, the outfall of which is at Portobello, about four miles to the east of Kemp Town. Its ventilation is materially promoted by means of a furnace at Roedean, the influence of which is felt at the Steine—a mile and a half or so to the westward. In his Report, pp. 7 and 8, dated 27th June, 1882, Sir Joseph Bazalgette wrote "that the ventilation at the time of his visit was quite satisfactory. The flow in this sewer is sufficient to remove all deposit, excepting a few inches in depth extending for a short distance above the Portobello outfall."

In an extensive survey of this sewer throughout, Dr. B. W. Richardson says, "The air of the intercepting sewer is much less offensive than would be expected . . . There was very little solid matter under foot. The masonry of the sewer is of brick, well laid, and seemed to be good in every part. By means of several storm overflows, ample flushing, and free

ventilation, this main sewer is maintained in a condition of wonderful purity." (Report p. 56, September, 1882). The surveyor informs me that in dry weather about 30 gallons per head, or over 4,000,000 gallons pass through it daily! All the tributary sewers at their upper ends are flushed twice a week by filling capacious man-holes "with water from the mains, and letting it go through them with a rush." As much as 428,420 gallons of water per week, or $22\frac{1}{4}$ millions per annum, are used for flushing purposes in this way. Connections with the sewers are made under the direction of an expert belonging to the Surveyor's office. "Altogether," Dr. Richardson sums up, "I found the working of the sewerage and drainage of Brighton entirely different from what I had been led to expect. I found no sewage deposit in the sewers, no leakage in the intercepting sewer, no special indications of escape of sewer air into houses. . . . I found, in short, nothing whatever that would lead me to believe in the occurrence of any special disease or mortality from bad drainage. I should add to this account that I experienced no ill effects from being so long in it while making my inspection, and that since it has been in use none of the surveyors or inspectors have ever suffered from using the air within it." (*loco. cit.*)

Ventilating shafts, carried to the tops of high buildings, have been constructed in numerous cases in suitable situations, and I trust these will be continued to be multiplied until all the street gratings can be safely dispensed with. So effective is the system now pursued in all its parts that disinfectants are not needed. It would, however, be an easy matter at the approach, or during the prevalence of an epidemic, to wash out every sewer, large and small, with a strong solution of any disinfectant that might be selected.

House Drainage.

But arterial drainage is not everything. Next, if not before it in importance stands the drainage of the house. Both systems are intimately correlated, and should be as complete as science and engineering can enable us to make them. To this ideal standard the Health Officer and Sanitary Committee direct their aims and aspirations. A house to house inspection is in constant operation. House sanitation is materially facilitated by the provisions of the Brighton Improvement Act of 1884, which arms the sanitary authority with several special powers in addition to those conferred by the Public Health Act and its amending Acts. The Sanitary Committee, ably advised

by Dr. Arthur Newsholme, are now seeing that every house is provided with a separate water supply for domestic use; that water set apart for flushing closets cannot be otherwise utilized; that the pipes leading from sinks, duly trapped underneath the same, are made to open through a wall in the open air over a channel leading to a properly trapped gully grating; that pipes of baths are similarly trapped and directed; that all badly placed stack pipes are thoroughly disconnected from soil drains; that properly ventilated, trapped, and flushed closets are employed; that the soil pipe at or near the point of issue from the closet trap is ventilated by means of a four-inch pipe (outside) leading above the top of the house, well away from chimneys, windows, and skylights; that the soil drain is effectually cut off from the sewer; that an air inlet to the chamber of the soil drain is applied of approved make (as yet we have no power to enforce this); that all cesspools discovered are closed, and the houses to which they belong are properly connected with the sewer; that houses found to be drained on the joint system are, with rare exceptions, each to be decided in committee on its own merits, separately drained; that new drains or old ones renewed are constructed of the best earthenware material, each jointed, laid all round in six inches of concrete, and only passed by the surveyor after having been proved to be watertight; that, as regards new buildings or old houses rebuilt, the adjoining sewer is, in suitable cases, ventilated well above roofs of such houses, whenever practicable; that all old wells are closed and filled up; that dust bins (portable zinc ones are the best) are kept as free as possible from putrid vegetable matter, emptied at least once a week or oftener, as in the case of hotels or other large establishments. Thus we are striving, as we have been doing during the past six years or more, to place all kinds of house property on the same level as regards the essentials of sanitation.

The Death-rate.

The census in Brighton is taken on the 1st of April, when the visiting community is at a minimum. It fails to take into account the 40,000 strangers daily present in October, November, and December, or an average daily number of 10,000 souls or more spread over the whole year. The death-rate, therefore, cast by the Registrar-General is greater than the true circumstances of the case justify. Then, as regards the fixed population, we have the high authority of Dr. Richardson for declaring "that no town in the kingdom is so subject to residence of

advanced and worn-out lives, and that it is fair to assume an increase of at least 1 per 1000 to the annual mortality from this social cause alone." Moreover, it suffers, in common with other health-resorts, but disproportionately, from the importation of persons who are sick and die, both in the public institutions and in the town, as also of those afflicted with the germs of transmissible disease. When, however, anyone is struck down with this kind of disease, the prospects of recovery are enhanced by the health-invigorating climate of the place. But in spite of the fact that the death-rate, as given by the Registrar-General, is higher than the true conditions warrant, it is, nevertheless, very satisfactory. The steady diminution of mortality extending over a long series of years revealed in the following statement indicates, in language which cannot be misinterpreted, the attainment of a large measure of sanitary progress:—

The (average) Death-rate.

During	the two decades	1851-60 to 1861-70	was	22·01	per 1000.
„	decade	1871-80	„	20·2	„
„	„	1874-83	„	20·0	„
„	„	1875-84	„	19·8	„
„	„	1876-85	„	19·3	„
„	quinquennium	1882-86	„	18·6	„
„	quatrennium	1883-86	„	17·8	„
„	triennium	1884-86	„	17·4	„
„	biennium	1885-86	„	17·1	„
„	annum	1887	„	16·9	„
„	„	1888	„	16·07	„
„	„	1889	„	15·04	„

Illustrating a decrease of 6·97 per thousand. This is not all. "It has been found," says Dr. Farr, "that in England, to *one annual death* in a body of men, two are on an average constantly suffering from sickness of some severity. . . . Although this exact relation is, perhaps, not preserved in infancy or old age, or where the mortality deviates much from the standard, it may be safely assumed as an approximation to the truth." Thus, according to Farr, for every annual death, there is disabling illness amounting to 730 days. Hence, it follows that the saving of 848 lives in 1889 signifies a diminution of sickness equal to 1696 years or 619,040 days. At a wage of fifteen or twenty shillings a week, this saving of life represents in money £66,144, or £88,192 per annum. And this does not take into account the saving of those unavoidable expenses contingent upon illness. The result implies a measurable increment in the

average duration of life, of reproductive labour, and an all round improvement in the condition of the public health. Viewed as a whole, it is one of the most striking, as it is certainly one of the most satisfactory instances of a steady and progressive response to sanitary reforms on record.

How much this reduction of mortality is due to the success of sanitary measures in diminishing the frequency of, and deaths from, infectious and tubercular disease, is well illustrated in the following statements, for which I am indebted to Dr. Newsholme :—

I.—*Showing the influence of better sanitary conditions in lessening deaths from infectious and tubercular disease.*

	1861-70.	1871-80.	1889.
Mean population	83,852	94,551	121,807
Total deaths per annum	1,846	1,934	1,833
Deaths from Small-pox	18	8	0
,, ,, Measles	35	26	46
,, ,, Scarlet Fever	53	37	18
,, ,, Diphtheria	22	8	10
,, ,, Whooping Cough	51	43	27
,, ,, Fever*	44	23	18
,, ,, Diarrhœa	102	100	64
,, ,, All Tubercular Disease	328	308	278

II.—*Showing the total number of deaths from all causes and the number of deaths from infectious and tubercular disease which would have occurred in an average year,* 1861–70, *had the population been as large as in* 1889 :—

	1861-70.	1889.	Decrease per cent. in 1889, as compared with average in 1861-70.
Population	121,807	121,807	
Total deaths per annum	2,681	1,833	about 32 per cent.
Deaths from Small-pox	26	0	,, 100 ,,
,, ,, Measles	51	46	,, 10 ,,
,, ,, Scarlet Fever	77	18	,, 76 ,,
,, ,, Diphtheria	32	10	,, 69 ,,
,, ,, Whooping Cough	74	27	,, 63 ,,
,, ,, Fever	64	18	,, 72 ,,
,, ,, Diarrhœa	148	64	,, 57 ,,
,, ,, All Tubercular Diseases.	478	278	,, 42 ,,

* Fever here means mainly enteric fever. Before 1871-80 it was not separated from typhus in the Registrar-General's Returns.

The percentages of decrease in the year 1889, as compared with the deaths which would have occurred from the several diseases in an average year of 1861–70, had the population been as large as in 1889, and recorded in the fourth column of this statement, are very striking. They mark the great success with which preventible diseases have been met and dealt with by the sanitary authorities of Brighton. They encourage us to anticipate even greater achievements in the near future.

Having briefly indicated some of the chief tests of the onward march of sanitation in Brighton, I now propose, in conclusion, to draw attention to a few reforms which are needed to secure her future position as a health resort.

1.—The most important of all is the effectual dealing with certain unhealthy areas. The ball has already been set rolling. The temper and feeling of the burgesses and their elected representatives regarding this matter are now flowing at full tide, and in the right direction. Doubtless the movement will be maintained with increasing momentum until all unhealthy houses and areas are swept away, and the houses of the artisans and other sections of the working and industrial classes are made as clean, bright, cheerful, and healthy as it is possible to make them.

2.—There is still room for improvement in the more frequent removal of dust, rubbish, and ashes. The prime objects to be aimed at are: (1) the transport of all decomposable material from the homes of the people before the process of fermentation has begun, thus depriving the germs of infectious disease of one fertile nidus in which they may germinate, grow, and multiply; (2) to get rid of odours erroneously attributed to imperfect house drainage; (3) to perceptibly reduce sickness and mortality, especially in the poor districts, and so increase the reputation of the town. In connection with this subject, the next object to be held in view is to have this refuse effectually burnt by means of a destructor situated at a safe distance from the inhabited parts of the Borough.

3.—The construction of an Abattoir (possibly more than one will be required) is a reform of the first magnitude. All that is now required is a good and convenient site. This having been secured the Council stand practically committed to a scheme for providing a public slaughter-house. With reference to this question, Dr. Letheby said, "There are advantages in every possible way to be gained (by having public Abattoirs) in the diminution of nuisance, better slaughtering of animals, better condition of the meat, in the better disposal of the offal, and also in the better supervision and examination." If, in addition, meat Inspectors were attached to see that none but healthy animals

were slaughtered for food, "visitors coming to Brighton would then be assured that they had there an advantage which has for so many centuries been of much important service to the Jewish people, an assurance which alone would be a great attraction." (Dr. B. W. Richardson.)

4.—All dairy stock should be accommodated outside the town. As things are now the animals must soon fall into indifferent health.

5.—Such an extension of baths and wash-houses as will meet the urgent wants of the inhabitants of St. Peter's and Preston districts.

6.—The construction of a grand swimming bath, comprising separate accommodation for the sexes, so situated as to meet the convenience of the people of the town generally. Here, all the boys and girls of our elementary schools should be taught the art of swimming as an integral part of their physical training, so that the rising generation of young men and women would have the great hygienic benefit accruing from this invigorating exercise, and be as much at home in the water as they are expected to be in reading, writing, and arithmetic, and other useful subjects of instruction.

In the sweeping away of (*a*) unhealthy houses and areas; (*b*) the reconstruction of the worst forms of tenement property; (*c*) the more frequent removal of ashes and rubbish; (*d*) the provision of an efficient destructor; (*e*) the housing of dairy cows beyond the boundaries of the borough; (*f*) such a further extension of baths and wash-houses as to minister to the needs of the inhabitants of the northern parts of the town; (*g*) the construction of a grand swimming bath, so planned as to give separate accommodation for the sexes, and so situated as to comply with the demands of the people of the town generally—there is, it must be admitted, still a wide field open for the further improvement of the public health. The execution of each of these reforms would be signalised by a well-defined reduction of the sickness and mortality. By adopting them all in their integrity, the death-tax would certainly fall from 15·04 to at least 10 per 1,000, or even less. Such a death-rate as this would enable Brighton to compare favourably with any of her genuine rivals, and to stand forth pre-eminently as the largest and healthiest seaside health-resort in the British Dominions.

Appendix.

Brighton Improvement Act, 1884.

Sec. 107.—Absolute power to close all cesspools.

Secs. 108-110.—Power to insist on provision of waste pipes

and special water supply to W.C.'s without service of notice. (Action, however, is seldom taken without serving a notice.)

Sec. 116.—Power to prevent filling up any land within Borough with offensive matters (made soils).

Sec. 118.—Power to purchase by agreement any houses which are unfit for human habitation.

Sec. 120.—Power to revoke slaughter-house licence if occupier convicted of selling, &c., diseased meat. This power is vested in the Magistrate's Court.

Sec. 121.—Power to prosecute in cases where unsound or diseased food is sold to customers before its condition was detected.

Sec. 122.—Power to open boxes, &c., for purpose of inspection of food.

Sec. 99.—No new house to be occupied until drainage and water supply has been completed, and surveyor's certificate given.

Sec. 100.—Height of new buildings shall not exceed distance from opposite side of street.

Sec. 55.—Corporation on certificate of M. O. H. may demand list of milk owners' customers. [This, at least in one case in my experience has led to the detection of a serious outbreak of disease.]

Sec. 58.—Penalty on those persons ceasing to occupy houses without disinfecting them if necessary, or not giving notice to owner, or making false answers.

Dr. Poore (London) expressed the indebtedness of the section to Dr. Ewart for his able paper, and said that the lessons he had conveyed to them showed how well the authorities looked after the sanitation of the town of Brighton. He thought it was extremely interesting to note the improvement mentioned in the last two tables, and he hoped that many of them would, on their return home, convey to their friends that Brighton was one of the healthiest as well as most popular seaside resorts on the coast of England.

Sir Douglas Galton (London) pointed out the inestimable advantage of complete isolation in cases of infectious disease by showing that London, since it had established at Long Reach, down the river Thames, a small-pox hospital, whither all small-pox patients were speedily removed, had never at any time had more than one, or perhaps two, cases of small-pox to record, so that in this case, at any rate, effective legislation was doing a great deal to stamp out a disease. With regard to the disposal of dust, he referred to a visit

he had paid in the spring to a place on the Thames near Chelsea, where an apparatus was used which in various ways made every particle of dust collected of some distinct use; some of it, after going through several processes, was made into brown paper; some was sold as breeze, and even for the old and broken crockery, when ground up, a good use was found. The apparatus was used, amongst other bodies, by the Chelsea Vestry, and he strongly recommended all towns who were thinking of a method of disposing of their dust to inspect this apparatus for themselves.

Mr. Henriques (Brighton) did not think with regard to house drainage that the present state of the law between landlord and tenant was conducive to good sanitation. House drainage had certainly greatly improved in recent years, but very few knew the difficulties that had to be overcome, difficulties which had been enormously increased by the strained relation between landlord and tenant. Tenants who were very highly rented were unable to carry out improvements, whilst landlords did not choose to incur the expense. In this condition of affairs it was the custom of public authorities with regard to sanitation in houses to make the owner liable for so much, and also to saddle the tenant with certain responsibilities. As this had an unsatisfactory result he recommended that the Sanitary Institute should consider the expediency of introducing a Bill into the next Session of Parliament, rendering the owner alone liable for all sanitary improvements. It would sooner or later, he held, become a legal question that no landlord should let a house until it was pronounced thoroughly fit for occupation, and there was no better method of attaining this great end than to make the landlord responsible. If the liability was thrown upon the tenant, the tenant was unable to pay because of his high rent. On the other hand the landlord could indemnify himself if the rent was low, whilst if it was high that of itself was a complete answer why no additional burden should be thrown upon the tenant.

Mr. Henriques' recommendation having been held to be quite in order, Dr. Ewart seconded it *pro forma*, and it was carried unanimously.

Mr. W. White (London) said, with regard to the remarks of Mr. Henriques as to the transfer of liability in regard to all sanitary matters in a house from the tenant to the landlord, that it was an arrangement very much to be desired, and he hoped that the Sanitary Institute would be able in due course to take the matter in hand with that object in view. The whole subject of legislation affecting sanitation was in a most disadvantageous condition as regarded the tenant.

On "The Value of Hygienic Knowledge to Women," by Dr. A. T. Schofield.

ABSTRACT.

Introduction.
Importance of subject.
Quotations from Herbert Spencer, Lord Derby, &c.
Present state of sanitation.
Storage of life.
Premature death.
Needless sick beds.
Money loss to Nation.
Value of public sanitation.
Deficiency of private sanitation.
Leading diseases.
Carelessness and ignorance.
Present apathy among the laity.
Necessity of general instruction.
Illustrations of this.
Three forms of ignorance—harmless but disgraceful; hurtful and injurious; active for evil.
Remedies.
Value of hygienic knowledge in care of children.
Illustrations of this.
Value in emergencies.
Value in houses.
Value in poor visiting.
Hints on preventive hygiene.
Doctors as Health Officers.
Present condition an anachronism.
Women's education still deficient in this science.
Remedies.
Value to teachers of young.
Value to nurses.
Money value.
Life value.
Conclusion.

On "*House Sanitation from the Householder's Point of View*," *by* Prof. W. H. Corfield, M.A., M.D.

ABSTRACT.

Prof. Corfield said that he had not intended to speak at a meeting of this Section, but to confine himself to judging at the Exhibition. He was, however, asked by the Congress Committee to make a speech upon House Sanitation, but he did not propose to treat the subject from a technical point of view.

In the first place, they knew that the result of defective house sanitation was the production of diseases of one sort or another. Bad ventilation or overcrowding resulted in the production, or at any rate in the spreading, of consumption. No matter under what conditions, if they had bad ventilation and overcrowding, and people breathed the same air over and over again, they would have consumption spread. When they had overcrowding beyond that which caused the spread of consumption they had typhus or gaol fever. Where overcrowding had been abolished this fever did not exist, and again, it did not spread where there was no overcrowding. He had known of cases of typhus fever being removed from overcrowded places to places which were not overcrowded, but had not known of an instance in which a second case was produced by the introduction of the patient, although it was one of the most communicable of all known diseases. This showed that it only existed and spread under one condition, and that was overcrowding. In consequence of bad drainage they had a fever known as typhoid or enteric, and this was only known to spread where the removal of excremental matters was not properly carried out, and the excretal matter fouled either the air or the water.

The Spread of Diphtheria.

Diphtheria had been attributed to defective sanitary arrangements, but now they were told they must not attribute it to any one cause, as one epidemic was the result of a different cause to that which led to another. However, there was a strong feeling that defective sanitary arrangements had to do with it. It used to be confined to villages, but now it was attacking London and other large towns. Sore throats often arose from gas from drains or escape of coal gas from defective

taps into bed-rooms, and there could be no question that a great variety of other diseases were made worse, and in many cases they might be caused, by defective sanitary arrangements. When disease appeared in a house it was the fashion to get the house inspected and have the sanitary arrangements put to rights, but now some were getting wiser, and having their drains inspected before the disease broke out. He now proposed to tell them what a householder could do to ascertain for himself if there was anything very wrong in the sanitary arrangements of his house. He did not propose that every man should be his own sanitary inspector, but he should have knowledge which would lead him to call in aid when it was wanted. The senses of smell and of sight must be employed; a bad smell in a house indicated bad sanitation of some sort or other.

A Word about Dust-bins.

Whenever they had bad ventilation or overcrowding, and when the air had been breathed over and over again, there was a smell of what they called stuffiness, and when they entered a room from the outer air and smelt this, they might be sure the place was not fit to live in. Stuffiness, too, was often produced by too much furniture and too many carpets and druggets. He need hardly go into details now as to how air in a room could be kept sweet. Another smell frequently noticed about a house came from the dust-bin. A dust-bin should not contain anything that would smell, but it was a well-known fact that in towns they frequently did. Dust-bins, too, should never be constructed against the wall of a house, as the smell got into the walls and was conveyed into the lower apartments, and often spread through the walls to the upper floors. The small tubes containing bell-wires which ran from floor to floor were often the means of conveying smells from the basement of a house to the drawing-rooms and bed-rooms. In many houses if they lit a piece of brown paper in the boot-hole, through which the bell-wires passed, or in some other place in the basement which was not particularly sweet, they would be able to detect the smell of it in upper rooms.

Defective Flues, and Gas in Bed-rooms.

Another smell arose from defective flues. The lining of flues was often cracked off and the brickwork laid bare, particularly where fierce fires were burned, and then the smells got through the walls into the rooms above. This smell was peculiar, but it was known at once to those who were accustomed

to it, although until they got used to it it appeared very much like the smell of a drain. The escape of gas in a bedroom, although it might not be detected by the gasfitter when he applied a light, was often not noticed except by the person sleeping in the room, who got a sore throat, and he (Dr. Corfield) thought it a mistake to use gas in a bed-room at all. He had known quite a sore throat epidemic springing up in houses, and especially in country houses, through the escape of gas.

Drain Pipes and Overflows.

Another cause of smell was the connection of overflow pipes with the drains, which pipes, as well as the waste pipes from sinks and lavatories, should discharge over traps in the open air. Even when they were disconnected smells sometimes arose through air coming from the outside up long pipes, which must necessarily become foul, and traps should be used to prevent this air coming into the house. A simple bend in a pipe—like the one he produced—was the best plan to adopt, as it was the most simple, and the trap was continually flushed by the water passing through it. No complicated form of trap should ever be used. Continuing, he said bad smells were often caused through water-closets and sinks not being next to the external walls, so that they could be ventilated from the exterior, although it might be thought that closets with a shaft running to the top of a house was properly ventilated. The building of a closet in the middle of a house was a far more serious matter than it appeared to be, for the pipes had to be carried down inside the house, and drains had to be laid underneath it, when this could often be avoided. He pointed out the great necessity of ventilating soil pipes, and then, alluding to the way in which the sense of sight must be used, said every occupier should make an inspection and see that all waste and soil pipes were carried direct to the outside of the house, and see that soil pipes had ventilating pipes of the same size running from them to above the top of the house and free from windows, and also from chimney stacks, which caused a downward draught when the wind was in a certain quarter. In conclusion, he pointed out the necessity of separate cisterns for the supply of drinking water and for closets, and also the necessity for a disconnecting chamber for the drain, with an inlet for fresh air not blocked with talc flaps or any such contrivances.

On "The Bearing of School-Attendance upon the Spread of Infectious Diseases," by ARTHUR NEWSHOLME, M.D., D.P.H.UNIV.LOND., Med. Officer of Health for Brighton.

SCHOOL life forms such a large portion of that of the nation, and engages such a large proportion of the total population, that its bearings on the public health are of the utmost importance to the whole community. I shall, in the remarks which follow, omit all consideration of private and other schools which are not under government inspection, and which do not receive grants of money from the Education Department. My remarks apply only to public elementary schools (board or voluntary). On the 31st August, 1889, there were 19,310 such schools in England and Wales, having accommodation for 5,440,441 scholars, and having on their registers 4,755,835 scholars; and an average attendance during the year of 3,682,625.

It is important for us in the first place to *ascertain whether these schools have caused an increased prevalence of infectious diseases.* Let me say at the outset that I am fully cognisant of the great benefits which will accrue to the whole community from a universal system of elementary education, that I have the utmost admiration of, and sympathy with, the teachers in their noble work; and that I value such education so highly that I should regard it as justifiable to incur considerable risks of increased prevalence of infectious diseases, were this necessary, in order to secure the advantages to be derived from universal elementary education.

Of the infectious diseases occurring at school ages, scarlet fever, diphtheria, measles, and whooping cough are the only four which need occupy our attention. Compulsory school attendance began soon after the passing of the Elementary Education Act in 1870, and the accompanying table shews the mortality from these four diseases before and since 1870.

Annual Death-rates per Million of the population from several Diseases.

	5 years, 1861—65.	5 years, 1866—70.	5 years, 1871—75.	5 years, 1876—80.	5 years, 1881—85.	4 years, 1886—89.
Measles	456·6	428·4	373·2	384·8	410·2	455·3
Scarlet Fever............	982·4	959·8	758·8	679·6	434·0	238·3
Whooping Cough	515·8	545·0	498·6	527·2	456·6	430·0
Diphtheria	247·6	126·8	120·8	121·8	155·6	157·3

It will be seen that measles and whooping cough have altered but little in their rate of mortality, during the period stretching from 1861 to 1889; that the mortality from scarlet fever has greatly declined; while that from diphtheria, though at the present time not so high as in the period from 1861-65, is higher than in the intermediate years.

Let us compare with this result the increased numbers who attend elementary schools. It will be seen from the following table, that while only 5·12 per cent of the total population were in attendance at elementary schools in 1870, the proportion steadily rose to 12·69 per cent in 1889; or stating the number in proportion to the entire population aged 5 to 15, it increased between 1870 and 1889 from 22·7 per cent. to 55 per cent.

Years.	Number in Average Attendance.	Per cent. of Total Population.	Per cent. of Population aged 5—15.
1870	1,152,389	5·12	22·7
1876	1,984,573	8·12	35·7
1880	2,750,916	10·77	46·7
1885	3,371,325	12·26	53·1
1888	3,614,967	12·62	54·5
1889	3,682,625	12·69	55·0

Compulsory school attendance begins at the age of 5 years. It usually terminates in the 13th year, or earlier. It will therefore be more satisfactory to compare the present death-rate from these four diseases at school ages, with the average death-rate from the same diseases in the decennium ending with the year in which compulsory school attendance became a part of the law of the land. I cannot obtain the death-rates for the ages 5-13, but the group 5-15 obtainable from the Registrar General's reports is sufficiently near for our purpose.

Death-rate per Million living, aged 5 to 15 years.

	10 years. 1861—70.	4 years, 1886—89.	Percentage Increase or Decrease.
Measles	141	162	+14·9
Whooping Cough	84	65	−22·6
Scarlet Fever	1387	309	−79·9
Diphtheria	272	247	− 9·2
From all Four Diseases	1884	783	−58·4

It will be seen that in the case of measles the rate of mortality has increased by 14·9 per cent.; in the case of whooping cough it has declined by 22·6 per cent.; and of diphtheria by 9·2 per cent. *at school ages.* The figures are on such a large scale that they are not open to the fallacies caused by accidental variations in different parts of the country or in single successive years. If we take these remarkable figures in conjunction with the fact that whereas in 1871 the number of scholars in average attendance at the elementary schools of the country formed 22·7 per cent. of the total population, aged 5 to 15, in 1889 they formed 55 per cent. of the population, aged 5 to 15, it will be evident that the association between school attendance and the spread of infectious diseases is not so close as is usually supposed.

It might, with a superficial show of reason, be argued from the preceding figures that school attendance has no tendency to increase infectious disease; and I think my figures prove that this tendency has been exaggerated in the popular mind, and even in the minds of many sanitarians. But it would be a serious error to conclude that school attendance has no such influence for evil. It is a matter within the experience of every Medical Officer of Health that the occasional attendance at school of children who are convalescing from, or in the earliest stages of an attack of an infectious disease, is a not infrequent cause of the spread of such disease; and in the case of measles we have seen that the present death-rate is higher than the death-rate which obtained during the ten years before compulsory school attendance began.

It becomes therefore an interesting and important inquiry to ascertain *how any such possibilities of evil may be still further diminished in the future;* and this will form the main enquiry of my paper. And in pursuing this inquiry I would say that first and foremost the Medical Officer of Health must have a complete and early information of every case of infectious disease. Now that compulsory notification of infectious disease has become so general (one might almost say universal), this object is attained in most districts in the case of scarlet fever and diphtheria. I am of opinion that similar knowledge should be attainable for measles and whooping cough, as either of them is more fatal to the community than scarlet fever or diphtheria. Such knowledge would enable us to educate the general public, and by judicious pressure gradually enforce the *complete isolation of all infectious cases* and the quarantine of healthy children in infected houses. It would appear, however, that in regard to whooping cough at least, the necessity for isolation has not been sufficiently grasped even in sanitary circles. This is

brought out by a letter addressed by the Society of Medical Officers of Health in April, 1886, to the clerk of the London School Board, in answer to a letter addressed to the society by the Board asking for information concerning certain infectious diseases. I must enter a mild protest against the following statement in the letter in question: "Again, in the case of whooping cough. If a child itself is suffering from this disease, it ought certainly to be excluded; but having regard to the fact that the danger from the disease is not so great at school-attending ages, the society would not prohibit the attendance of healthy children coming from infected families." In order to support my objection to the plan allowed in the passages quoted, I must make a somewhat detailed statement. The age of the scholars in elementary schools has an important bearing upon the point in question.

Now, in 1889, of the total number on the school registers—

31 per cent. were under 7 years of age.
66 „ „ between 7 and 13 years of age.
and 3 „ „ over 13 years of age.

I am obliged to assume that the *mortality* returns furnish a fairly reliable indication of the relative prevalence of the four infectious diseases under consideration at different ages, as no very complete figures of the total number of *cases* of any one of these diseases are available.

The following table shows the proportion of the deaths from these diseases occurring at different ages during the year 1888 :–

	Total Deaths at all ages.	Percentage of Total Deaths occurring from each Disease.					
		Under 1 year.	1—3	3—5	5—10	10—15	At all Higher Ages.
Measles	9784	20·2	54·9	16·3	7·6	0·5	0·5
Whooping Cough	12287	44·0	42·3	10·2	3·3	0·1	0·1
Scarlet Fever	6378	5·7	30·9	29·3	25·3	5·1	3·7
Diphtheria	4815	5·1	24·1	26·8	31·2	5·7	7·1

It will be noted that the largest percentage of deaths from all these infectious diseases occurs between the ages of 1 and 5, and this applies especially to Whooping Cough and Measles.

It is usually supposed that the number of children attending school at these ages is very small, and this impression was evidently shared by the Society of Medical Officers of Health, when the letter which I have quoted was written. As a matter of fact, in 1889, 464,144 children on the registers were below 5 (or 9·3 per cent of the total scholars at all ages), while 1,031,626 were between 5 and 7 years of age (21 per cent. of the total scholars).

I have no figures giving the proportion of deaths from the above four diseases between 5 and 7 (the smallest group given by the Registrar-General being 5 to 10); but an examination of the above table will show that whooping-cough has, at least, 13·5 per cent. of its total mortality between the ages of 3 and 10, and 10·2 per cent. of its total mortality between 3 and 5, when a large number of children are in attendance at school. That *a very considerable proportion of the mortality from whooping-cough occurs at school ages*, is further shown by the following table taken from the 51st Report of the Registrar-General, and founded on the experience of the whole country, from 1848 to 1887.

Annual Death-rate per Million living at each age or group of ages.

		Period taken for Calculation.	Under 1 year.	1—2	2—3	3—4	4—5	5—10	10—15
Measles.	Males	1848—87	3011	5812	2883	1599	926	236	25
	Females ...	Do.	2515	5462	2935	1680	956	259	32
Whooping Cough.	Males	1848—87	6769	4930	2071	1086	584	118	5
	Females ...	Do.	7306	6223	2954	1629	859	179	10
Scarlet Fever.	Males	1859—87	1664	4170	4676	4484	3642	1667	346
	Females ...	Do.	1384	3874	4491	4332	3556	1613	381
Diphtheria.	Males	1859—87	464	720	675	757	690	337	100
	Females ...	Do.	356	665	731	835	782	434	147

It will be evident from this table that although the death-rate from whooping cough is not so high between 3 and 5 as that of scarlet fever, it is higher than that of diphtheria, and if, as is generally acknowledged, it is desirable to keep apparently healthy children in an infected household away from school in the case of diphtheria, there is no valid argument against the same course being adopted for whooping cough. I would maintain that "having regard to the fact," that 10·2 per cent. of the total deaths from whooping cough occur between the ages of 3 and 5, at which ages (or at least at all ages below 5; some are even younger than 3 years, which would strengthen my case) 9·3 per cent. of the total scholars on the registers of English Elementary Schools are attending school, it is the bounden duty of all Medical Officers of Health to use their best endeavours to prevent the attendance of children at *infant* schools, so long as a case of whooping cough remains in the same house. I do not think we should be justified in keeping *all* children in the infected house away from school; but I would commend to your favourable attention the practice adopted in Brighton, *of keeping all children away from the infant school* who come from a household where whooping cough exists.

In regard to the other diseases named, I believe there is no discrepancy of opinion. It is recognised that whether the disease is scarlet fever, diphtheria, or measles, the parents must be warned against allowing other children in the house to attend school. I fear it is not an equally universal procedure to warn the teacher against admitting children from infected houses to school. Parents will persist in sending their children to school, notwithstanding advice from their medical attendant or the sanitary officials; and the fact that this occurs every day, is one of the strongest arguments for the compulsory notification of whooping-cough and measles, as well as of scarlet fever and diphtheria.

The intimation should be sent direct from the Sanitary Office to the head teacher of the school, aud not indirectly to the School Board, as has been suggested. It is only by the former plan that the tedious delays of officialism can be avoided, and the efficacy of the intimation as a preventive measure secured.

In some towns, I believe, the plan which I have introduced in Brighton is adopted; but, as it appears to be rather the exception than the rule, I append a copy of the circular letter which we forward to the head teacher when an infectious case occurs in a house from which children attend school. If children from the same house attend in the boys', girls', and infants' departments of a school, a letter is forwarded to the head teacher in each of these departments. The plan works smoothly, and with little expenditure of time and labour, and I have reason to believe that it is very efficient in preventing infection. It also leads to friendly relationships with the teachers, and to their giving every possible information on points relating to the public health.

"Health Department,
Town Hall, Brighton.

PRIVATE.

........................189

Dear............

....

of .... is now ill at home suffering from ....

He should not be allowed to return to School for........... days, and during the same period no other children from the same house should be allowed to attend School.

Yours very truly,

ARTHUR NEWSHOLME, M.D.,
Medical Officer of Health."

I cordially acknowledge the help which I have always found teachers ready to render in preventing the children of infected households from attending school. But on another point I must enter an emphatic protest against a practice which is, I believe, fraught with danger to the public health. This is the practice of sending scholars to enquire the cause of absence of absentees. The usual practice adopted is for the teacher to enquire of his or her class, "Who lives in the same street as John Jones?" (naming an absentee). "Then will you take this note and enquire why he is not at school this morning?" In cases which have come under my own observation, children thus sent by their teacher have been ushered directly into the living-room, in which children suffering from scarlet fever or measles or some such disease are lying. The answer usually given by teachers when I have protested against this practice has been, "Oh! we do not send children when we know that there is infectious disease in a house." Of course not! But then there are the 99 out of every 100 cases in which the cause of absence is unknown; and I am in a position, from personal experience, to say that the practice is highly dangerous and most objectionable. It is easy to understand why the teacher is so anxious to secure the regular attendance of his scholars. Even if his income does not directly depend on the percentage of passes he secures (and I am glad to find that this system of payment by results is steadily tending to become obsolete), yet his professional reputation and future promotion are largely influenced by the results he obtains; and these results are in a great measure determined by the regular attendance of his scholars. In addition, a large proportion of the Government Grant is given on the basis of the average attendance, and there is therefore every inducement for both teachers and school-managers to urge the early return of absentees to school. In one case which came to my knowledge, two children, just convalescing from measles, were offered one penny each if they would be sure and come for the Government Inspection on that day!

But it will be said, there are special school-attendance officers whose duty it is to look up absentees. This is true, but their number is quite insufficient to cope with irregularity of attendance. They can only deal with the more persistent truants, whose parents may need magisterial interference. The rule in Brighton is for these officers to look children up who have been absent 3 or 4 times out of 10 possible attendances per week. That they can do no more is shewn by the fact that in Brighton there are only six attendance officers, while in May of this year there were 16,951 on the rolls of the

elementary day schools of the towns, and 13,351 in average daily attendance. This means a daily average of 3,600 absentees, divided among 23 boys' schools, 33 girls' schools, and 35 infant schools, and implies 600 visits per diem for each officer, if complete and daily oversight is to be maintained.

Then again, such visits of the attendance officers are only made after 3 or 4 days' absence; and what the teacher is anxious to ensure is that any scholar who is absent from school for half-a-day shall be looked up, and the parent urged to enforce regular attendance.

Several years ago, in consequence of a report by me, this subject was brought before the London School Board, and the Board, I believe, announced that they "discouraged" the practice of which complaint was made. But it is notorious that the practice is almost universal, and that something more than "discouragement" is required. I can scarcely blame the teachers for doing as they do under the circumstances. The only remedy which appears to me to be practicable, is to have a special officer in connection with each board school and voluntary school appointed by the school board, whose duty it would be to look up absentees morning and afternoon. His duties would in no way clash with those of the present attendance officers. It would be his duty to hand over obstinate cases to the latter, to be dealt with by legal measures or otherwise. Some such plan as I have suggested would remove a great danger from our midst, and would I believe, if combined with an absolute veto against home visitation by scholars, relieve teachers from their present anxiety to secure by every means a good average attendance.

I began this portion of my subject by inquiring how the danger of infection, in connection with school life, may be reduced to a minimum; and I have advocated in this connection— (1) the compulsory notification of measles and whooping cough, as well as of scarlet fever and diphtheria; (2) the complete isolation of infectious cases and the quarantine of children in infected houses; (3) that whooping cough in a house should be no exception to the rule, but should preclude all children of the same house from attending infant schools; (4) that the Medical Officer of Health should give prompt and direct intimation to the head teacher, of any case of infectious disease among his scholars, and instruct him as to the duration of the infectious period; (5) that teachers should be strictly forbidden to send children to enquire the cause of absence of absentees, and that a special officer should be appointed for each school to visit such absentees.

Two other measures remain to be considered.

(6.) The importance of instructing parents and scholars in the

laws of health. Much mischief in spreading infection is done in ignorance, an ignorance which is so crass and pertinacious that it is difficult to realise that the sin is not being committed against light and knowledge. As I shall have something to say on this evil and its remedy on Thursday, I need not further dilate on it to-day.

(7.) The closure of schools, owing to the presence of infectious disease among the scholars, is a step which has been frequently taken of late years, but it is one the frequent necessity for which I very much doubt. If we had compulsory notification of whooping cough and measles, as well as of scarlet fever and diphtheria; if the sanitary staff in each district were efficient in numbers and sufficiently energetic, such a measure would, in my opinion, be only required under one condition, viz.:—when insanitary conditions in the school itself had given rise to disease. But as matters now stand, an epidemic of measles not uncommonly reduces the average attendance of a school by one half before the Medical Officer of Health is fully acquainted with its existence. Under these circumstances it is sometimes necessary to recommend the closure of a school, especially when there are reasons for believing that the children meet chiefly if not solely in school. What we require is prompt and complete information of every case of measles, and then it would, I believe, be seldom or never necessary to close a school on its account. Let erysipelas and puerperal fever be expunged from the list of notifiable diseases (or at least the first of these), and let measles take their place. It is true that considerable expense would be incurred at first by such notification, as measles so rapidly spreads; but its rapid spread is largely due to our ignorance of its presence, and to the fact that we have hitherto scarcely attempted to cope with it. We have, in scarlet fever, an instance of what preventive measures can effect; if measles be more difficult to deal with owing to its infectiousness before the rash appears, let us not be daunted by the task, but do our utmost to secure complete and prompt information in regard to it, and we shall then have done much to add it, as well as whooping cough, to the list of diseases which are becoming steadily diminished by sanitary measures.

Dr. Strong (Croydon), in commencing the discussion, said the lecturer had not denoted whether the mortality arising from whooping-cough was divided at all as to the time of year, because that would have a vast influence on the number of deaths. As to the

question of constituting teachers administrative officers under the conditions suggested, he was opposed to the idea, and held that there should be an Infectious Diseases Officer, who should himself go to the house of illness and investigate the circumstances of the case. The spread of measles he thought might be traced to the fact that the working classes thought so little of it. Then, although people were so particular in not allowing their children to go with others when those others were recovering from illness, yet when their own children were unwell they thought they could not possibly give their companions anything.

Dr. Sykes (London) dwelt upon the case mortality, which had an important bearing upon the relative value of various diseases. The mere whoop did not constitute whooping-cough. He was doubtful of whooping-cough being as prevalent as it was stated to be. With regard to measles, that ought to be notified because it was a specific disease. If each disease was allowed to stand on its merits the case would be met.

Mr. H. H. Collins, F.R.I.B.A. (London), as Chairman of the Sanitary Committee in Paddington, was glad to learn that there was unanimity of opinion in including measles among the diseases which ought to be notified. A curious circumstance had been encountered in making investigations into the outbreak of diphtheria in Paddington; it was, that in almost every instance, upon measles had supervened diphtheria. It was not for him to say that the causation of diphtheria was measles, but certain it was that diphtheria had supervened, and with very disastrous results. At all events, the circumstance showed the absolute essentiality of making measles one of those diseases which should be notified. That the remarks which had been made were justified was shown by a recent report of the Local Government Board, in which, out of six cases of diphtheria outbreak which had to be inquired into, in every instance the cause of the dissemination of disease had been through schools. He also insisted upon the necessity of obtaining information at once.

Dr. Armstrong (Newcastle) said that in the town he represented measles was most fatal. Schools were always blamed by poor people, sometimes rightly and sometimes wrongly, as the source from which the children had caught the disease. He considered the principals of schools should be informed that various diseases became infectious and the time they continued to be so. With regard to scarlet fever especially, school principals and others had very little knowledge of its period of infectivity; he favoured certificates of health being required at the opening of each session in schools.

Dr. Kempster (London) took it that the practical outcome of the paper and discussion had rather tended to show that the Medical Officers of Health were unanimously of opinion that measles should be included in the list of notifiable diseases. He was sorry he could not agree

with Dr. Sykes as to the character of whooping-cough, for the mortality arising from the two diseases combined had greatly exceeded all other mortality from zymotic diseases. He thought it would be a great thing if some expression of opinion could go from them that measles should be included in the notifiable diseases, and he should like to move a recommendation to that effect.

Dr. A. Newsholme, in answering the comments which had been made upon his paper, said he thought it should simply be the duty of the head teacher to prevent the children from an infected house from coming to school. He thought it would be better, perhaps, to consider measles and whooping-cough apart, to first make measles notifiable and let whooping-cough come afterwards.

On "A National Health Service," by The Hon. F. A. R. Russell.

ABSTRACT.

The objections to the exercise of a strong and uniform State control and supervision do not hold in respect to infectious diseases. These evils arise from causes which are well known, and can be greatly reduced by the application of certain well-known principles by a central authority, having the advantage of full information concerning the distribution of infectious diseases throughout the country from day to day, and of the services of sanitarians of the highest skill and ability. Most localities do not take much interest in bringing their districts to a high degree of salubrity, and many medical officers receive so small a salary that their occupation as such is disregarded in comparison with their private practice, which they are still allowed to pursue. In fact, the Sanitary Acts in the rural districts and in very many small towns are a failure, and through this failure the whole nation suffers. A neglected village may be the cause, through milk, water, or ordinary intercourse, of destructive epidemics in neighbouring or even distant towns or counties. Infective diseases ought, like fire, to be under the constant and effective supervision of an authority for the whole area over which the destructive power is likely to spread if unchecked, and this area, in the case of infection, is the whole country. A Ministry of Health might learn, from the notification already adopted by over three-fourths of the

country, the distribution and progress of various diseases, and its officers might be continuously conducting a campaign against them by the best known means.

The conditions which favour the spread of infection are so well known that there would be little difficulty in arresting an outbreak at its inception. The experience of the Westminster Sanitary Aid Association was that even in the midst of a crowded population, and in the case of so easily caught a disease as scarlet fever, it was possible to confine the fever within very narrow bounds. The Sanitary Aid Association of Hastings almost put an end to infectious illness in that town, although of course many visitors must have resorted thither before being perfectly safe. In fact, few Local Authorities have attained the degree of immunity from zymotic disease which is really possible for the whole nation to reach, if willing to conform to certain rules which are beneficial both to the sick and the healthy. Diseases arising from impure conditions of water, or air, or milk, can be easily reduced in their places of origin, and prevented from spreading by isolation and disinfection. But the amount of knowledge, training, and authority required to deal adequately with them is such that no body, other than a Government or National Department, could fitly undertake the task. And when these infections are constantly travelling beyond county boundaries, even a County Council cannot keep their ramifications within view. Rabies was never put down with very much success except by State Authorities, for the same reason, that it is carried rapidly from place to place, for the rabid dog runs. But where the Government deals seriously with rabies, by general muzzling and care respecting imported dogs, hydrophobia ceases to exist. It is also becoming apparent that the only right way of dealing with the pleuro-pneumonia of cattle is to place the responsibility altogether in the hands of the Central Authority, and to obtain thus the prompt and scientific treatment which was not always given by the counties.

The plan recommended by the Joint Committee on State Medicine, of the British Medical and Social Science Associations, still appears the best which can be devised. By it there was to be created, instead of the many local authorities now existing, one elected and representative body, clothed with all executive functions, whether municipal or sanitary, within the area of its jurisdiction. The Health Officers of the County Boards were to be men of high scientific attainments and acknowledged ability; paid adequate salaries for superintending the whole or a division of a county; to these were to be added medical officers of districts, and all were to form one great Department of the State, under the presidency of a Minister of

Health, but all these officers were to be under central control, so far as making up one great body of workers for general State medical purposes.

The fact is, infectious disease is not merely local, and cannot be dealt with effectually by Local Authorities, because if one is active, another is negligent, and because such separate and uninformed Authorities cannot attack the enemy with anything like the force or precision of a trained brigade. There is no escape from the urgent need of State control in respect of epidemic and spreading diseases, for a single neglected district is a danger to the whole nation.

On "The alleged danger to Public Health, arising from effluvium nuisance from Gas Works," by WALTER HEPWORTH COLLINS, F.C.S., F.R.M.S., &c.

FROM time to time public attention has been drawn by various means to the offensive smells emanating from the process of gas manufacturing and other operations incident thereto, and such odours have been credited with producing or encouraging various ailments of a more or less serious character.

The influence on the death rate by many of our manufacturing industries carried on in large populated towns, is a department of public health which appears to have been somewhat neglected by our various sanitary authorities; when however, either by some accident or design, their attention is directed to the subject, they attribute, perhaps through misinformation or ignorance as to precise nature of the so-called noxious industry, so many and peculiar causes of sickness as to render the suggestion absurd.

Recently, however, it has been suggested by eminent sanitarians that the effluvia from gas works are of a most injurious nature, and in fact absolutely deleterious to health; and further, that they are a most important factor in considering the high mortality of some of the larger manufacturing towns in this country.

This suggestion is of great importance, and as there does not appear to be any recent data of a reliable nature as to the condition of the air in the immediate vicinity of, and the alleged injurious effluvia arising from, works of the character in question,

one of the objects of this investigation has been to secure such data and place it on record in the Transactions of this Institute, where it will be readily accessible for reference.

The gas works of such towns are, as a general rule, situated at the lowest accessible level, and, particularly in the case of old works, are surrounded by cottage or other property of an indifferent character; the adjacent neighbourhood being tenanted usually by the lower labouring class, whose sense of smell would not appear to be of a cultivated or refined type.

The process of gas purification is subject to constant change and improvement, and therefore it may be as well to briefly state at this stage the ordinary cycle of operations usually carried on in a large modern works, in the neighbourhood of which these investigations were carried out.

The crude gas from the retorts and hydraulic main is first conducted to the condenser, and its temperature reduced to about 60° F., when much of the watery and tarry matter is thrown down. It is desirable not to reduce the temperature of the gas below 58° F., so as to avoid depositing the naphthalene and other valuable illuminants, and consequently impoverishing the gas.

The gas is then led on to the exhauster, which is a mechanical contrivance for reducing the pressure on the retorts, for helping the gas forward through the purifying apparatus, and for other purposes which it is unnecessary to describe in detail here, inasmuch as the machine plays no part in the specific purification. The gas at this stage is very crude, and any leakage or escape would undoubtedly cause a most offensive nuisance, as it contains large quantities of sulphuretted hydrogen, ammonia, carbonic acid, carbonic oxide, and cyanogen compounds. Most of these are affected, and some removed in the next process of purification—washing and scrubbing. The apparatus generally consists of a large chamber (of various forms) mechanically arranged so as to offer a large surface, constantly "sprayed" with water, to the gas. The water in this apparatus practically absorbs the ammonia, and, when not saturated with this gas, such quantities of the carbonic acid, cyanogen, and sulphur compounds as the ammonia can combine with, and thus forming carbonate, sulphide, and sulphocyanides of ammonia. The water is then the "gas-liquor," or ammoniacal liquor of commerce. The gas is then led on to the "purifiers," which are either of lime or hydrated oxide of iron, or both, and here the carbonic acid is removed, and the noxious sulphur compounds reduced in the gas to a practically non-injurious quantity. The cycle of purification is thus complete, and the gas passed on to the holder ready for consumption.

We now come to consider the character of the nuisance arising from the retort house, and also from the purification processes above referred to, and their general bearing on the public health. The greatest nuisance is undoubtedly due to the smoke given off during the charging and drawing of retorts; to the generation of "water-gas," when the red-hot coke is quenched with water; to the escape of crude-gas from the mouth-pieces of the retorts; to the smoke given off from imperfectly "carbonised" charges; to the firing by the stoker of the tarry matter and dust accumulated in the retort mouth-piece during distillation; and to the long smoky flame emitted from the retort when the lid is removed on account of a stoppage in the ascension pipe.

All these operations, when indifferently carried on, are offensive, and undoubtedly cause a most dangerous nuisance.

The following analyses show the condition of the air flowing from the ventilators of the retort-house roof. The samples were taken from different gas works, A being in a densely-populated town, B being a small works situated in the country. Both samples were highly charged with fine dust of a carbonaceous character.

TABLE A.

	A.	B.	
Carbonic Acid	2·29	7·31	Per cent.
Carbonic Oxide	4·26	9·36	"
Ammonia	6·23	9·41	Milligrams in cubic metre.
Sulphuretted Hydrogen	7·16	12·5	" "

The air outside the gas works, 250 yards away in each case, had the following composition:—

TABLE B.

	A.	B.	
Carbonic Acid	2·03	Trace.	Per cent.
Carbonic Oxide	None.	None.	"
Ammonia	0·095	Trace.	Milligrams in cubic metre.
Sulphuretted Hydrogen	Trace.	None.	" "

The above analyses show how rapidly the noxious gases are dissipated, and also indicate the precise source of the nuisance.

Both samples in table A. are of a foul and highly dangerous nature, and should be utilized or conducted into a "destructor" or chimney stack. The following analyses are of a sample of air taken in the gas works yard, four yards from the "condenser":—

TABLE C.

	A.	B.	
Carbonic Acid	1·93	Trace.	Per cent.
Carbonic Oxide.....................	None.	None.	"
Ammonia	0·16	Trace.	Milligrams in cubic metre.
Sulphuretted Hydrogen.........	Trace.	Trace.	" "

From this table it appears that no appreciable nuisance arises from the "condenser."

The "washer" or "scrubber" does not appear to pollute the air very much, as the following analyses show :—

TABLE D.

	A.	B.	
Carbonic Acid	1·96	0·09	Per cent.
Carbonic Oxide.....................	0·03	0·04	"
Ammonia	0·03	0·06	Milligrams in cubic metre.
Sulphuretted Hydrogen.........	0·04	Trace.	" "

The purification house, however, is a source of nuisance, the smell being most offensive, especially where lime is used for the removal of those sulphur compounds which have not been intercepted by the condensing and scrubbing operations. When lime is used for absorbing the carbonic acid alone, no nuisances whatever are caused; but when it has been used for the removal of both carbonic acid and sulphur compounds, it proves a most offensive nuisance. Being in the form of sulphide, sulpho-carbonate, or polysulphides of calcium, most of these are liberated when this purifying material is exposed to the atmosphere, by the action of the carbonic acid and oxygen in the air; the sulphuretted hydrogen and bisulphide of carbon are consequently released, and create a really disgusting and poisonous nuisance. When, however, natural oxide of iron is used, either alone or in conjunction with lime, the nuisance is

reduced to a minimum—the lime being used for absorption of the carbonic acid alone, and the iron-oxide for securing the sulphur compounds.

The following analysis indicates the state of the air issuing from the ventilator holes in the purifying house where lime alone is used:—

TABLE E.

Carbonic Acid	None.	Per cent.
Carbonic Oxide....................	None.	"
Ammonia	1·61	Milligrams in cubic metre.
Sulphuretted Hydrogen.........	41·93	" "

The following table shows the state of the air in the purifying house where lime and iron-oxide are used separately:—

TABLE F.

	Lime.	Oxide of Iron.	
Carbonic Acid	Nil.	Trace.	Per cent.
Carbonic Oxide....................	Trace.	Trace.	"
Ammonia	Trace.	Trace.	Miligrams in cubic metre.
Sulphuretted Hydrogen	0·04	0·009	" "

Another alleged source of nuisance is the utilization or "working up" of the ammoniacal water or "gas liquor" containing the polysulphides of calcium previously referred to, and its subsequent manufacture into sulphate and other salts of ammonia. I have made analyses of the air adjacent to a large sulphate of ammonia plant, with the following results:—

TABLE G.

No. of Sample.	Grains per 100 cubic feet.			
	Carbonic Acid.	Ammonia.	Sulphuric Acid.	Hydrochloric Acid.
17	0·46	16·7	56·3	16·3
21	0·49	16·5	40·2	16·1
27	0·46	16·1	41·6	16·9
24	0·43	16·9	51·9	17·0

This analysis shows that the air is highly charged with

chemical vapours of an irritating and noxious kind. The plant was of the most modern construction, and turning out a large quantity of ammonia salts per annum.

Having before us the foregoing tabulated results of analyses of the air from various parts of the gas works, we are in a position to trace any nuisance to its source, and also have sufficient data as to the condition of the air on which to base an opinion as to its action on health. These results also show that the larger works situated in populous places cause less nuisance than the small works situated in the country; probably the latter presume upon their position, and conduct their operations in a more or less careless manner. There can, however, be no doubt whatever that if the operations referred to in this paper are not carefully carried out and stringently overlooked, they will be a most prolific source of nuisance and danger.

The Sanitary Institute has done most valuable work in directing attention to and suppressing many evil nuisances and dangers to public health, and its action in regard to smoke abatement, of course, includes the abatement of noxious fumes or smoke from gas works.

Dr. Ballard in a report to the Local Government Board in 1878 states, "In the various processes of distillation of the coal, purification of the crude gas, and disposal of the condensed matters and refuse, offensive emanations are apt to be given off, such as to cause the neighbourhood of gas works to be shunned by all who can afford to reside elsewhere. Medical men are usually ready to certify that the effluvia are injurious to public health, probably referring the effects produced on those who are exposed to their influences in a diluted form, to the operation of the sulphuretted hydrogen as a poison. It is certain that exposure to the diluted effluvia from sulphate of ammonia works, does in many cases induce feelings of depression, headache, loss of appetite, nausea or vomiting, and sometimes some oppression of breathing."

With reference to this statement of Dr. Ballard's, it will be noticed that in the appended table of air analyses, the sample from the centre of the town of Bolton, highly polluted by smoke, is actually worse than the sample from the sulphate of ammonia works on the outskirts of the town.

I would refer to the following authorities who have observed the action of these and similar gases on public health. The air of towns may be vitiated by respiration, combustion, effluvia from the soil, sewers and trades. The movement of the air tends however, to continually dilute and remove these impurities, and the heavier particles deposit, so that air even of manufac-

turing towns is purer than might have been anticipated [1]. Manouvriez [2] says, that workmen in the coal and tar distillation works suffer from melanodermy, cutaneous eruption, and affection of the eyes, ears, and nose; bronchitis with pulmonary pseudo melanosis, and gastro-hepatic disorders. Hirt [3] also mentions a similar state of things due to the same cause. The [4] normal quantity of carbonic dioxide being ·4 vols. per 1,000, it produces fatal results when the amount reaches from 50 to 100 vols. per 1,000; and 15 to 20 per 1,000, produces severe headaches.

Of [5] the effect of carbon monoxide there is no doubt. One per cent. has been fatal, and less than half per cent. has produced poisonous symptoms. This [6] gas replaces oxygen in the blood, volume for volume, and cannot be again displaced, so that the person dies asphyxiated; Powrowski [7] has shown that it may be converted into carbon dioxide. The evidence with regard to the effect of sulphuretted hydrogen is not of a conclusive character. Hirt [8] has noted the following symptoms of chronic poisoning in men working in the neighbourhood of gas-works: slow pulse; weakness and depression; furred tongue; mucous membrane of mouth pale, as also the face; emaciation and head symptoms "like a case of slow-running typhus." Josephson and Rawitz [9] found two forms of disease produced: narcotic and convulsions, and tetanic symptoms. Spasms, tremblings, and even tetanus sometimes followed. *Carburetted hydrogen* [10] can be breathed for a short time, but it eventually produces symptoms of poisoning, convulsions, and vomiting. *Ammoniacal vapour* [11] has a marked and irritating effect on the conjunctiva, but there is no reliable evidence of any other action. *Sulphur dioxide* [12] causes complaints of bronchitis. *Carbon disulphide* [13], referred to in the early portion of this paper, seems to act on the nervous tissue with a direct anæsthetic effect in so far as it produces giddiness, headache, pains in the limbs, depression, loss of appetite, deafness, dyspnœa, and even amaurosis.

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[1] Parkes' *Hygiene*, p. 122.
[2] *Annalis d'Hygiene*, March 1876.
[3] Hirt-*Die Krankheiten der Arbeiter*, and also Eulenberge - *Gwerbe Hygiene* 1876.
[4] Taylors' *Jurisprudence.*
[5] *De Sanguine Oxydo-Carbonico infecto*—Lothar Meyer.
[6] Virchow's *Archiv.*, Band xxx., p. 525.
[7] Op. cit., Band xxxii., p. 450.
[8] Op. cit.
[9] Schmidts' *Jahr*, Band cx., p. 334 et seq.
[10] Hirt, op. cit.
[11] Parkes' *Hygiene*, p. 132.
[12] Parkes' op. cit.
[13] Constatt's *Jahresb*, Band vii., p. 76.

TABLE H.—BOLTON.

	Carbonic Acid.	Ammonia.	Organic matter.	Solid matter.
Air—Lum Street	0·36	16·1	29·4	61·0
„ Gas Street	0·41	16·4	29·9	71·2
„ Town Hall Square	0·62	16·9	33·1	16·9
„ Trinity Street Station	0·71	16·7	33·6	17·4
„ Bradshawgate	0·49	17·1	31·4	20·1
„ Farworth	0·96	17·6	29·7	21·6

TABLE I.—MANCHESTER.

	Carbonic Acid.	Ammonia.	Organic matter.	Solid matter.
Near Rochdale Road Gas Works	0·39	13·1	21·0	14·3
Queen's Park	0·061	6·1	6·2	4·3
Central Station	1·31	26·0	9·9	42·3
Victoria Park	0·006	0·91	7·6	16·9
Deansgate	0·613	2·46	29·3	46·4
Piccadilly	0·714	3·10	27·6	61·0

TABLE J.—MICRO-ORGANISMS.

	Bacteria.	Moulds.	Total Micro-organisms.
Lum Street, Bolton	16	5	24
Gas Street, Bolton	17	11	28
Town Hall Square, Bolton	31	106	137
Near Rochdale Road Gas Works, Manchester	19	20	39
Central Station, Manchester	29	76	105
Victoria Park, Manchester	36	69	105

On "The Relations between Taxation and Sanitation," by S. M. BURROUGHS.

As it is the desire of the Sanitary Congress to consider matters likely to encourage the construction of healthful, commodious, and substantial dwellings, I venture briefly to point out the

relations which undoubtedly exist between taxation and sanitation.

Sanitation science has already done very much to improve the healthfulness of our houses, but still in many cases much remains to be done, and everything tending to promote the erection of better buildings will be of interest to our members. The hindrance to the building of good houses is chiefly in the matter of the expense of first cost, but the question of taxes is an important one, because, in the course of time, the amount of taxation may exceed the amount of the initial cost of construction.

Everyone building, buying, or leasing a house at the present time must consider that the taxes will be levied upon it in proportion to its size, healthfulness, and the desirability of its position.

If the rooms are sufficiently large, and are suitably ventilated, if the walls and roof are substantial, if the house contains a bath room, with hot and cold water, and with suitable sanitary arrangements for securing the comfort and health of the occupants, the taxes to be paid will be much higher than if the house be small, or badly built, or lacking a bath room and other sanitary arrangements.

Taxation is thus seen to be a hindrance to the erection of good houses, and sanitation would doubtless be much promoted if the burden could be removed or mitigated.

I remember once seeing in a northern town a remarkably well-built house, roomy, healthful, and well situated, which was empty because the builder and owner could not afford to live there on account of the heavy taxes he would have to pay upon it if occupied, and for this reason he was obliged to live in a small and less healthfully constructed house.

In the interests of the public health it therefore appears desirable to encourage the building of good houses, by making the tax on good and healthful houses no higher than on insanitary houses. In fact, I believe that taxation on houses can be remitted altogether without hardship toward anyone, by simply transferring the tax from the house and the improvements to the land value.

Let us, for instance, suppose the case of a man who buys a piece of land for £1000, and erects upon it a house costing £1000. The present rating is on the improvements, and depends upon whether occupied or not. The rental value of such a house and lot would be, say £100, and the rates would amount to, say £30.

Let us now suppose the entire taxation transferred from the house or improvement value to the land value alone. It is no

hardship to the owner, for his taxation is not increased, or his right of possession interfered with in any way, but as the tax is now solely on the land value, he is free to extend his house, add to its sanitary arrangements, and improve its comfort and healthfulness, without being taxed or fined for doing so.

The exemption of manufacturing and industrial establishments from taxation has frequently been the determining cause of their foundation and prosperity in particular spots, and the result has of course been a marked increase in prosperity in those parts of the United States offering such advantages. Moreover, history informs us that the reason why manufactories of various kinds are so much more numerous in the northern than in the southern parts of England, is, that in early times such industries were entirely exempted from taxation in the north, while they were liable for rates in the south.

The encouragement towards construction of good houses is apparently as important as the presence of manufacturing industries, and there appears no good reason why both should not be equally exempted from taxation, especially as the unearned increment, which is created by the growth, industry and thrift of the public, is the most anciently accepted as well as the most convenient and easily assessed subject of taxation.

This simple procedure would be beneficial in many ways: for example—

1st. It would greatly encourage the construction of good houses, with all necessary sanitary appliances.

2nd. There would be a considerable increased demand for labour in consequence of building, etc., which would advance wages, and consequently the purchasing and consuming power of the community, resulting in an increase of the general prosperity.

3rd. If the land values created by building of roads and railways were taken in taxes to pay for them, and for the expense of running and maintaining them, then travel would be free, town and suburban lands would tend to equality in prices, congestion in towns would be greatly relieved, and the country would be more thickly populated in places where space and fresh air are plentiful.

Briefly, a long vista of beneficial reforms conducing to the social and sanitary welfare of the people would follow upon the removal of taxation from industry, and the transfer of all taxation to unearned increment or land values exclusive of improvements; that is to say, values not directly created by those who now profit thereby, but indirectly resulting from the energy and enterprise of the public.

Lastly, the disuse or nonuse of lands or houses should be rendered a costly luxury by discontinuing to offer a premium to the speculator waiting for a rise in the shape of exemption. Land which is deliberately rendered unproductive should be coaxed back into the domain of usefulness by making it a burden to the possessor. This can readily be done by assessing all lands at their value for use irrespective of improvements which would amount to the exemption of improvements from taxation and give the greatest incentive to industry and progress.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS

By Prof. T. ROGER SMITH, F.R.I.B.A.

PRESIDENT OF THE SECTION.

"*BATHS.*"

The Queen of Watering-places hospitably receives the Sanitary Congress this year; accordingly some topic growing out of the material circumstances which make life at a watering-place so different in its conditions from life in an ordinary town, seems not inappropriate as the subject of the address which I am to have the honour of delivering before the members of the section of Architecture and Engineering.

There is ample matter for both the architect and the engineer to deplore to consider and to improve, as there is also much that may be recognized as admirable, in the Architecture and the Engineering of our health resorts. But I do not propose to attempt a critical examination of all this, but rather to deal with a more compact and manageable topic, and one which has the advantage of carrying part of the benefits of a watering-place to our own homes and our own neighbourhoods. I will therefore ask you to consider, during the time at our disposal, the subject of Baths, especially such baths as may be accessible to the people.

A general and well-founded impression prevails that the Romans were skilled in the construction of baths. Indeed, in most places where Roman remains exist, some traces of a bath are to be found; but the practice of the Romans was so

remarkable, and the public baths, or Thermæ, erected in Rome during the Empire, were such wonderful structures that it is worth our while at the outset to direct our attention to them; the more so, as my argument will be that it is our duty at the present day to try to accomplish for the inhabitants of our towns and cities, though in an entirely different way and by means widely dissimilar, the same result which those vast and lordly structures accomplished for the citizens of Rome.

The Roman Citizen, even if he was a poor and mean man had access to the conveniences, appliances, comforts, and luxuries of the Thermæ. Part of that which he there found our citizens dispense with; but that part with which we have to do to-day—the means of promoting health by bathing—remains in too many cases as yet out of the reach of our people.

On the sanitary value of the bath and of bathing it is hardly my province to enlarge, but I must not pass it over without a word. No part of the human body is so accessible as the skin, and its great extent and intimate relation to all other parts of our organization alike point it out as requiring care. The ailments which are due to a chill disturbing the functions of the skin are perhaps the most numerous of all to which we are subject in this country, and not the least deadly; and they are to no small extent preventable by the habitual use of the bath, and to a considerable extent curable by its means. The vast group of rheumatic and gouty complaints, if they yield to anything, yield to baths properly applied; but beyond all this, general health seems largely dependent upon cleanliness, and habitual neglect of the bath is not only contrary to our notions of self-respect and decorum, but is insanitary. The skin cannot perform its functions properly when it is not cleansed, and if the skin be out of order, every part of the animal economy suffers more or less.

To return, however, to the Roman Thermæ, they were vast establishments each wonderful both for extent and completeness. Each of them was the gift of an individual emperor to the nation. They stood in different parts of Rome. They were accessible to the citizens, and at an extremely small price: at one time half a farthing (a quadrans) seems to have been the charge. They may be looked upon as having been political bribes on a gigantic scale, as it was in order to secure the favour of the mob that they were put up. Professor Aitchison, in his lectures last year before the students at the Royal Academy, gave the most learned and complete account known to me of the Thermæ; and he has with great kindness enabled me to exhibit some of the illustrative plans and drawings which he prepared, and in part of what I am to say about the Thermæ,

I shall have to remain a debtor to the published report of his lectures.*

The Thermæ combined provision for various descriptions of public occupation and amusement—such as athletics, public lectures and discussions, games, libraries and picture galleries, with the most complete system of baths possible. How various the sorts of bath (not to speak of the other departments) were, may be well stated in Prof. Aitchison's words. The Thermæ included "cold, tepid, warm, hot, vapour, and swimming baths, and possibly hot-air baths as well. To some of these baths fresh, sea, and mineral waters were supplied. In the baths people were oiled, scraped, shampooed, shaved, plucked, singed, pumiced, and perfumed, and in them they sometimes took refreshments, and seemingly on occasions dined there. There were reservoirs for the water, shops or lodgings in the peribolus, and barracks for the vast army of slaves that attended to the bathers, the baths, the furnaces, the reservoirs, the gymnasia, the palæstra, and the grounds. Workmen to repair and foremen to direct were probably resident there, and there certainly must have been vast stores of wood and pitch for the fires, stores for oil, towels and strigils, possibly even rooms for washing and drying the towels; and when the baths were kept open of a night and lit up, this must have required stores for the lamps and places for cleaning and trimming them."

The general disposition of one of the most complete of these great establishments was as follows:—A vast space, usually nearly a square, was enclosed by walls and by buildings of moderate height. In this quadrangle, but so placed as to leave much of the enclosed space unoccupied, was planted a compact block of lofty and magnificent buildings, consisting of vaulted and domed halls and baths of great solidity and beauty, combined with buildings for gymnastic exercises, all grouped together with great skill and art. In these structures the work of the bath was carried on, while the outer range of low buildings consisted partly of shops, partly of accommodation for slaves, partly of buildings for other purposes, and partly of water-tanks and cisterns.

We will take the baths of Caracalla as an example, because they are the best preserved, and they have been very fully investigated and illustrated. The rectangular outer enclosure had a frontage of 1108 feet, or within a trifle of one-fifth of a mile, with a depth slightly less, namely, 1060 feet, and a large

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* I am also indebted for the loan of illustrations, or for information or both, to Mr. Phéné Spines, Mr. C. C. Walker, Mr. Palmer, Mr. E. A. Reynolds, Mr. George Jennings, Mr. C. H. Rosher, and other gentlemen.

additional piece of land was occupied by water-tanks. These Thermæ took up, with their reservoirs, $31\frac{1}{4}$ acres.

The main group of buildings covered slightly more ground than the Houses of Parliament, including Westminster Hall, and though in quite a different style of architecture was fully as elaborate and costly.

At each end of this main building there was a gymnasium, that is to say, "exercising places for the citizens, which probably included schools for learning the various exercises and sports," here also were halls and cloisters where lectures and discourses were delivered, and libraries. The two gymnasia were exactly alike in plan, each had a large open quadrangle in its heart, surrounded by a cloister or arcade, and to each was attached a group of baths.

The central part of the building contained the great baths, it had two entrances, and between them the noble piscina or swimming bath. Beyond lay, in the very heart of the block, the tepidarium or warm hall, a splendid vaulted hall, 180 ft. long, 79 ft. wide, 108 ft. high to the vault, and with a chamber 79 ft. by 56 ft. at either end, the three making a group 292 ft. × 79 ft. The dimensions of course must fail to convey a very definite idea of such a hall, but it may illustrate their magnitude to point out that the main hall with *one* of the subsidiary ones, was about equal in length to the central hall of the Law Courts, and more than half as wide again. The three together, were both longer and wider by about ten per cent. in each case than Westminster Hall. The central hall alone was slightly larger and slightly wider than St. George's Hall, Liverpool.

This last building is the only English interior that I can name which gives any idea of the mode in which buildings such as this tepidarium were vaulted; and the richness with which they were treated does not appear to have been equalled by any modern European interior, though St. George's Hall (just alluded to) and the interior of the Madeleine in Paris, may be pointed to as examples of the same sort of architectural treatment, and indeed very possibly, both of them, more refined if very far less magnificent. I have dwelt upon the splendour of the tepidarium, as it was the noblest part of the whole, but each portion was as rich and as solid as could be. In the tepidarium it seems probable that the bathers undressed. From thence they proceeded to a hot room, calidarium, and then to the hottest room, the laconicum, a circular domed hall 116 ft. in diameter—that is to say larger than the dome of St. Paul's, but not nearly so high, with immensely thick walls, and so placed as to catch almost all the rays of the sun, and with hot-air flues under the floor and lining the walls. This, of course,

was used much as is the hottest room of a modern Turkish bath. There were other halls and rooms, the purposes of which it is not now possible to distinguish with certainty, but they were, of course, appropriated to some among the many different processes carried on in the Thermæ.

To complete a very cursory notice of this vast building, I would point out that south of the main block was a great enclosed space suitable for races and games, overlooked by a vast grand stand, consisting of raised seats, at the back of which were the water-tanks. At each end of this space was a great recessed building arranged for use in connection with these exercises. Of the furnace-flues and underground arrangements for heating, water-supply and drainage, the traces are to a large extent obliterated, but they must have been of vast extent.

What was provided in the baths of Caracalla was, with differences of detail and scale, provided also in those of Agrippa, Nero, Titus, Trajan, Diocletan, and Constantine. Ancient writers state that the baths of Caracalla could accommodate 1,600 bathers; and as, of course, persons came and went, and many went for other purposes than bathing, it seems not unreasonable to suggest that such an establishment alone would accommodate more than three times that number in the course of a day, or say 5,000 persons. When one thinks of the vast initial expense; of the army of slaves required to work each establishment and to cleanse it; of the endless provision of wood for heating the furnace and the hot rooms; and of the skilled supervision, it is manifest that such an extraordinary group of structures could only exist in a city like Rome, whose armies had overrun the civilized world and laid every country under tribute, so that vast wealth—not the produce of taxes in Rome itself, but wrung from the various subject countries—was at the disposal of the Emperor of Rome. Of this wealth use was made in a variety of ways, but I think we may safely say that there was no one municipal object to which so much was devoted as to the establishment and maintenance of public baths.

If this sagacious people attached such importance to baths for the million, is it not worth while to ask ourselves whether our attention has been sufficiently directed to this object.

We look upon ourselves, and not without reason, as having in many respects a national greatness not inferior to that of the Romans. How different is the nature of our national life from theirs, at least at the period of the Empire, may be strikingly illustrated if we ask the question how far the average British subject can enjoy the amenities which the Roman found waiting for him at the Thermæ.

The magnificent, if ostentatious, display of architecture sculpture and rich ornament has no parallel in anything English that is open to the people's enjoyment. The nearest approach was formerly made by our Cathedrals, but they have been cruelly shorn of their embellishments, and they have ceased to be places of habitual resort for the many.

In our public picture galleries the art of painting has, it is true, a means of reaching the crowd, but in displays of the other arts Roman magnificence eclipses our attempts.

The second source of popular entertainment and delight was the gymnasium, where races, wrestling matches, and all kinds of sports were to be seen, and where also amateurs had full opportunity for indulging in the exercises. Here, though our sports are more peaceful and far more humane, and the way we manage things quite different, we need not fear comparison. The crowds who throng Lord's or the Oval, the vast concourse of people at the University boat-race, at Epsom, or at Ascot, and a score of other instances, bear witness to our admiration for athletic sports. Every village green, the playing fields of every public school, our countless tennis lawns, show how keen English amateurs are in the pursuit of such exercises.

The Roman, at the Thermæ, heard the news, attended public discussions, lectures, and recitations, and so cultivated his mind. The English citizen has the advantage, whatever it may be worth, of buying for a penny the verbatim reports of Parliament of the night before, and his pennyworth includes all the news of the day from spots whence intelligence would have taken months to reach Rome; so he probably must be considered to have the best of it in this particular.

The fourth great business at the Thermæ was the one which interests a Sanitary Congress. The Roman frequented the Thermæ to keep himself in health, and for a very trifling sum had the opportunity of using a most complete system of baths arranged for that object. Has the English citizen any such opportunity, and if not, can we procure it for him? The answer to this question will occupy the rest of our time, and bring us face to face with a problem of great public importance, and one to which attention needs to be directed far more than at present.

From the baths of the Romans, it appears natural to pass to the modern hot-air bath, known by the name of Turkish Bath, in which the bather goes through a course, which is supposed, and with reason, to bear a general resemblance to what the Roman Thermæ afforded.

The true Turkish Bath, as given in Eastern cities, is a more severe and prolonged treatment than is undergone in a modern

English bath bearing that title. Prof. Aitchison's account of what he underwent in a bath at Cairo gives a complete description of what must be a somewhat formidable process.*

In an English Turkish bath the visitor first divests himself of his boots, and then undresses in a room provided for the purpose. He is then conducted into a hot room of which the atmosphere is dry as well as hot, and remains for some time till a profuse perspiration breaks out—hardy bathers venturing into an inner and hotter room. He is then shampooed, though not always with much thoroughness, he is then deluged with soap and floods of warm water, and then often has a needle-bath, *i.e.*, a bath where water is thrown upon him from a number of fine perforations. The temperature of this is gradually lowered so as to cool the bather down. Then follows a plunge into cold water, and the victim, wrapped up in towels, may then repose in a cooling chamber, and enjoy well-earned rest, with perhaps refreshment, till he is minded to dress and depart. The accommodation for all this should be all on one floor—airy, commodious, open. An ample supply of hot air and of hot and

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*" I was first ushered into a vast hall lit by a lantern, with a raised seat for the bath-keeper, and a baldachino over the coffee stove, with a fountain in the middle of the hall. The whole hall was gorgeously painted, and had towels drying on the beams, which the attendants hung up and took down by means of long bamboo poles. A little above the main floor were a series of carpeted compartments, each as big as a small room. Here I undressed and wrapped myself in cloths, while my interpreter folded up my clothes and tied them up in a sheet. I was then led by an attendant across the hall into a dark passage, and was ushered into a darkish hot room where I sat on a marble seat, and I was gradually moved from room to room, each of which was hotter than the last, until I was taken into a light domed room with a central peristyle, in the middle of which was a large steaming tank of water, with steps running down into the water. The walls were lined with white marble, inlaid with coloured in patterns; the domed porticoes of the peristyle were plastered, and lit by star-shaped openings—several in each dome—the space between each arch and the wall being domed.

" Within the marble margin of the bath was a gutter. I was laid down at the side of it, rubbed with a horsehair glove, and then soaped over and scraped with a sort of artificial sponge, composed of dried grass resembling diminutive bamboo. I was then washed by hot water being poured over me from a large copper cup, and when this was finished I was made to walk down the first step and sit down with my legs in the water, which was nearly scalding. I was then made to sit lower and lower till I was up to my middle; the attendant then went into the water, caught hold of my hands, and jumped me into the hot water, and put my head under it several times. I was taken back by the passage into another darkish room, where two marble basins projecting from the wall were running over with hot and cold water; water was dashed over me from a cup, at first hot, afterwards tepid, and at last quite cold, and I was led back to the place where I undressed. I was then dry shampooed, and every joint in my body cracked, including my backbone, both backwards and sideways. After my dry shampooing I was covered up, laid on a cushion, given a cup of black coffee and a narghiley. I felt quite refreshed."

cold water, and well-considered means of carrying water away are indispensable, as is also the means of providing hot and dry air at any temperature and in great volume. As a good many attendants are wanted, considerable provision for them is requisite, and the bathers occupy a good deal of space, so that, altogether, a Turkish bath, which many persons attend, requires large and specially-arranged premises, and must, I fear, always remain a somewhat high-priced luxury. It affords an excellent opportunity for effective architectural treatment, and it is no doubt a very valuable sanitary agent, but the hot-air bath cannot, at any rate as at present administered, be reckoned upon as the bath for the million.

Perhaps it may save recurring to the subject, if I refer here to the vapour bath as an appliance which, combined with a needle bath or spray, is capable of being used in any ordinary bathing establishment, and of exciting something of the same sort of action on the skin as the Turkish bath. This appliance it would be possible to introduce into establishments where inexpensive baths are given with advantage. In some cases patients who are advised that the Turkish bath is not safe for them, are allowed a vapour bath, as the head is always kept out of the box in which the body is steamed. Still this more simple appliance cannot supply the popular bath that I desire to advocate.

A very considerable number of establishments, some of them opened as private speculations or by small companies, but the most part provided under the Public Baths and Washhouses Act, exist. Mr. Rosher states the number of public baths in England having a swimming-bath as part of their installation, at 200, out of which seventy are in the Metropolis alone. The avowed aim of many of these—especially of the Parliamentary ones, if one may be pardoned the phrase, is to reach the general mass of the people. In addition to the washhouses, which form no part of our present subject, we find in one of these establishments one or more swimming-baths and a series of warm baths. Let us examine the nature of each of these two provisions, beginning with the swimming-bath. Those who desire further information as to the Baths and Washhouses Act and its results, will find it in a compact and serviceable form in the comprehensive report of Mr. Ernest Turner on the subject, prepared at the time of and in connection with, the recent Paris International Exhibition.

The swimming bath is necessarily a more or less public institution. It is in its nature large and expensive to establish and maintain, but it is almost unequalled as affording to great numbers a means of healthy pleasant exercise, and as furnishing

an opportunity for the young and others to acquire the valuable art of swimming. No pains should be spared to make it attractive as well as convenient.

A swimming bath of modern construction is a large tank, usually long in proportion to its width, shallow at one end and fairly deep at the other, walled in and roofed over, with a floor all round and numerous dressing boxes. The interior should be light and airy, the water should be sufficiently warm, perfectly fresh, bright and clean, and the dressing boxes should secure some degree of privacy. As the swimming bath, if successful, will be worked pretty hard, it is necessary to have the means of rapidly and thoroughly cleansing every part in use, and of quickly emptying and refilling the bath. Gas or other lighting should be provided. In some cases provision may be made for employing the bath as a room for public meetings or a gymnasium, or in some such way during the winter time when it is not in request.

Let us look into the means of carrying out this programme.

The most important part of the whole, the swimming bath tank requires to have extreme care bestowed upon its construction lest it should leak. Portland cement concrete is so well fitted for constructing the bottom and sides, that it is not now likely that, save under exceptional circumstances, any other material will be used; formerly brickwork backed up by clay puddle was the best material available, but there was more chance of leakage, and it is said that defects were not infrequent. The pressure of the water against the bottom and sides is not formidable in amount, but the various weights are quite sufficient to cause a partial failure if the foundation gives way, so every care must be taken to ensure a uniform and solid foundation for the bottom, and similar support for the sides, as the smallest settlement will be followed by a crack, and the crack by a leak. Cement concrete is not itself water-tight, and a lining of almost pure cement is required. The actual face of the tank should be of glazed brick or tiles, though when economy is of importance, this may be dispensed with. Bands of dark brick or tile running from end to end of the bath are sometimes introduced into the bottom as a guide to swimmers in swimming races.

It is desirable to put in, at least the foundations of the external walls before beginning to dig for the bath tank, so that the excavation for the baths, when once made, shall not be again disturbed. If the tank be dug and concreted first, the subsequent disturbance of the earth in digging for the footings of the enclosing walls may be enough to cause a crack.

Any outlets and inlets required should be decided, as to both

size and position, before beginning; and the valves, sluices, &c., put in as the concreting goes on, so that there may be no excuse for disturbing the work and cutting holes in it. I know of one successful case where the side walls of the tank were first formed in trenches, and then the dumpling, or great mass of earth in the middle, was got out, and the bottom put in last of all; but there is some risk of making a bad join, and it is better to excavate the whole before beginning to concrete, and then to do the bottom first, and to bestow especial pains and not to stint material in making the join between bottom and sides.

The water at the shallow end should be rather over three feet deep, sloping to about six feet at the deep end, and it is not uncommon to have the deepest point about ten feet short of the end, so that persons diving in may plunge iuto the greatest depth. However this may be, every part of the bath must slope sufficiently to one point, to enable the water to be completely run off from the bottom. For cleansing purposes the corners and the join between the bottom and sides should all be rounded so as to prevent any lodgment for dirt. It is desirable to have along the shallow end a perforated pipe with water laid on, so that when the bath has been emptied the attendant may be able, when necessary, to turn on a shower of water while the tank is being cleaned out. The depth of the water should be legibly painted at the sides in several places. The edge of the paving should be rounded, and between it and the water there should be a space of about six inches, and here a stout teak rounded handrail, or an iron pipe two inches in diameter, should be securely fixed on brackets for bathers to hold. The perforated pipe already alluded to may serve this purpose where it occurs. It is desirable also to fix spittoons at regular distances round the edge of the bath, and there should be a stout step-ladder at each corner.

The dimensions of the tank must be settled with regard to the probable number of bathers and the means disposable. Every additional foot adds to cost of original construction and of maintenance, but adds also to the value of the bath to the bathers. For a public bath, less than 25 ft. width and 60 ft. length of water area is not desirable. The length may, with great advantage, be increased to 70, 80, or 90 ft., then the bath should be 30 ft. or even more wide.

At most baths there will be swimming clubs, and races will be sure to be instituted, and these festivals have to be considered. Less than 5 ft. width will not do for a racer, so that not more than five competitors could well race in a 25 ft. wide bath, and four would be more comfortable. It is rather desirable, in the interests of the races, to have the length an even number of

feet divisible by ten, then three laps make a similar number of yards, and 60, 70, or 80 yards can be swum readily in a bath 60, 70, or 80 feet long.

The water delivered into the bath, whether pumped up or from the mains of a water company, will be too cold for bathing in most states of the weather; and how to warm it is a most important point, for it is not only essential to be able to raise the temperature from the point at which it is delivered, which may probably be from 50° to 60° up to say 75°, or at least 72° Fahrenheit, but it ought to be uniformly raised through the entire mass of water in the bath. If there are cold zones and hot zones in the water, bathers will not like it, and a bath that is disliked will be of comparatively little use to its owners or the public.

In some cases hot water and steam is circulated in pipes within the bath itself, the pipes being as a rule fixed in a recess formed for them in the walls of the bath. In others a long chamber is formed outside the bath tank and filled with hot water pipes or steam pipes, and the water is admitted into this cool and returned to the bath warm. In another arrangement the water is drawn off from the bath, heated in a furnace, and returned warm. Sometimes steam is simply blown into the bath itself, an expeditious but noisy way of raising the temperature. Most of these plans are more or less liable to heat the water unequally, and in more than one of them there is apt to be introduced a pipe, or a jet, or a something which is found to get too hot for bathers to touch without injury. The plan, the results of which, so far as my experience extends, are the best, is one differing from all these. It was put up for me at the baths of the Carpenters' Company, at Stratford, by Messrs. Fraser, and I can speak strongly of the success of this apparatus as a means of warming the water uniformly and effectually, and helping to keep it fresh.

At the deep end of the bath and near the bottom an iron pipe is introduced, which is carried (outside the tank) back to the shallow end, and to which the water has free access. In the course of this pipe is introduced an iron chamber, into which a powerful jet of steam under considerable pressure is thrown; this acts upon the contained water on the principle of a Giffard's injector and hurries it on, so that it is returned into the bath travelling at some speed, and of course the water that takes its place is drawn out at the same speed. The steam mingling with the water in the chamber raises its temperature, and the result is that a stream of warmed water is always pouring in near one corner of the shallow end of the bath, while an equal quantity of cold is always leaving at the opposite end. The

temperature is by this simple means gradually and equably raised to what is required, and is easily maintained; and what is satisfactory is, that the warmth is found to be uniform all over the bath, and that as the water is always in gentle motion it keeps remarkably clear.

A method resembling that of Messrs. Fraser, but carried further, is that of Mr. C. H. Rosher. He employs either the steam-jet just described, or a pump to effect a circulation of the water in the bath tank during the heating process; but he admits the heated water at the bottom of the tank, distributing it over the floor of the bath by discs or spreaders. It is claimed that this method promotes uniformity of temperature, and rapid heating, and prevents steaming from the surface of the bath and loss of heat.

With this system of heating this engineer combines a second improvement, directed to secure economical working of a bath. The heaviest expense in working a swimming bath is usually the cost of water. It will take about 60,000 gallons of water to fill a bath 25 ft. by 80 ft. This, at 6d. per 1,000 gallons, a usual price, will cost £1 10s.; and should the bath be refilled daily, except Sundays, the expense would be £9 per week for water only, in addition to the cost of fuel used in warming the incoming water. Mr. Rosher proposes to filter and to ærate the water by appropriate machinery placed in a small chamber formed for the purpose, and so to render the same supply fit to last much longer. Filtration will, it is considered, remove the solid impurities, such for example as those which the settlement of dust on the surface of the water occasions. Aeration will oxydise, and so neutralise some organic impurity. I believe this system has been successful at Woolwich and other places, where it has been tried; and there can be no doubt that a plan which will diminish the amount of water used in a bath without rendering it less pleasant or less healthy, promises to effect a very great economy in working. Other plans for filtration have, I believe, been brought forward, but this is the most complete that has come under my notice, and the only one which includes a provision for constantly recharging the water with air.

The rest of the swimming bath may be dismissed more briefly. There should be a platform not less than four, and better, five to six feet in clear width at the sides, and ten feet at the ends, and at the deep end a stage should be erected for diving. The interior should be bright, but direct sunshine on the bathers is undesirable. A bath is best lighted by a series of ample side and end windows, but generally there is not room for that, and a great skylight has to do duty, which it does very well.

There should be ample ventilation under the control of the

attendant and not of the bathers. Ventilation in a swimming bath is a little difficult to maintain without discomfort to the bathers, especially when the atmosphere is much colder than the air in the bath. A few steam pipes or hot water pipes to warm the dressing boxes are of essential service, both to aid in this and to keep the place comfortable in cold weather, though it must not be forgotten that the large mass of tepid water radiates heat into the chamber that contains it.

There should be near the entrance a small shallow bath supplied with hot and cold water and a tepid spray; often called a soap hole; for bathers who come in from dirty work and desire to wash themselves clean before plunging into the swimming bath.

A small laundry for towels and bathing dresses should adjoin, and can be worked by the same boiler as supplies steam for heating water for the swimming bath and the warm baths. It will include some tanks, a boiler, a centrifugal wringer, and a hot closet; and my experience, as far as it goes, is that the hot closet will be better worked, and with more certainty, if it has an independent furnace, and is heated by hot air, than if the heat be obtained from a steam coil.

Turning now to the other part of an establishment of public baths, we find a provision of warm baths, similar to that familiar appliance for bathing now rarely absent from any good private house, the ordinary warm or slipper bath. This name was, I believe, given at a time when it was often customary to cover over the small end of the bath, so as to produce something not at all dissimilar to a brobdignag slipper. We will use the name, as it is distinctive, though not now quite descriptive. It is at least better than plunge bath.

The slipper bath varies between 5 ft. and 5 ft. 9 in. in length, and is always wider at the end intended for the shoulders. An average bath is about 2 ft. wide at the top where widest, and slopes down every way; and when filled sufficiently for comfort will generally be found to contain not less then twenty-five gallons of water, and often much more, reaching sometimes to fifty gallons. Usually about one half of this quantity will be hot water, though this depends on the temperature at which the hot water is delivered.

A great deal of ingenuity has been expended upon improving and cheapening slipper baths. The best probably are of earthenware, enamelled; copper enamelled is very much used, as are iron and zinc. Marble used to be used. At the brine baths at Droitwich baths of teak are largely employed, and they are there preferred to those of any other material, partly on account of their retaining the heat, and partly because they do not feel at

all slippery. I am told there is no difficulty in keeping them perfectly clean.

Where it can be afforded every such bath should have an independent dressing-room, and it is often of advantage for the bath-room to have two dressing-rooms, one on each side. Suitable dimensions are for the bath-room about 10 ft. by 7 ft. 6 in., and for the dressing-rooms 10 ft. by 6 ft. 6 in. In a room of this size the bath should stand clear of walls at either side. In cool or cold weather these rooms should be heated, and if the dressing-room can have a little fireplace and a small open fire, it adds to the sense of comfort. A hot closet for keeping towels, &c., hot and dry, is a desirable adjunct to any complete set of slipper baths. Hot and cold water is, of course, laid on to each bath, and the attendant's duty is to fill the bath and bring it to a proper temperature.

When baths for the many are constructed the above programme is too luxurious. One compartment must then do duty as bath-room and dressing-room. The minimum size for such a room is 6 ft. by 5 ft. 6 in., but a little more space is very desirable. The bath fittings are usually so arranged as to give the control of the hot and cold supply to the attendant, who will add more of either from the outside if called. The floor of the bath room should be covered, or partly covered with open wood lattice work, to keep the feet of the bathers dry. The enclosure of the bath-rooms may be formed of sawn slate or even of galvanised and corrugated iron in wooden framework; and it is important that the cocks and valves should be strong and well made and asbestos packed, as there will be much wear and tear.

In some cases, baths of a shape different from the received slipper bath are used for the warm bath. At Buxton, for example, a warm bath is a kind of tank lined with marble, and with steps leading into it at one side and a kind of bench at the other. The patient takes the bath in a sitting position and not reclining, and when it is wished, as is sometimes the case, that the lower limbs only should be bathed, he sits on one of the steps. If he sits on the bench he is immersed nearly to the chin. In the same baths, the mineral water which comes up at a temperature of 82° is used in baths which are also small tanks or pits, but large enough for the bather to move about in freely —say (speaking from memory) 5 ft. by 8 or 9 ft.

As Buxton has been mentioned, perhaps it may be appropriate here to say that I have felt that it would extend the scope of this paper too far, and carry me away from what is its special aim, were I to take up the elaborate and skilfully contrived appliances which are to be met with at such places as Bath

or Buxton, and at the principal continental resorts, such for example as Aix-les-Bains, for administering thermal and other waters as curative agents. Still less is it proposed to touch upon hydropathy or the appliances employed in water-cure establishments. To-day I am endeavouring to direct attention to appliances fit for the use of the people, rather than to the more costly and special ones designed for the treatment of special diseases.

It must be admitted that while the operation of the Baths and Washhouses Act has brought a means of bathing within the reach of large numbers of people, it has not gone far enough. I believe it has been the experience of the Managers of many of these establishments, that they are not frequented to such an extent as to make them self supporting; and it needs no long consideration to see that the prices charged, though very moderate even if they reach the maxima fixed by the Act, do not place the bath within the reach of every class of working people; while the mere fact that these establishments must be on a considerable scale, and therefore cannot be very close together, removes them from the easy access of some of those who would use them if they could.

Can we bring the bath nearer to the doors of the people, and can we give them a cheaper bath than anything accessible at present?

As to bringing baths nearer to the homes of the people, we shall, I am informed, have particulars of what has been done in Brighton itself.

In London and other crowded towns and cities I have no doubt that simple, cheap, and accessible bathing establishments, formed in crowded neighbourhoods, set up as a rule in existing buildings, and adapted to the wants and the purse of the crowd, would be popular and largely used; and my impression is that they could be made to pay their expenses, and possibly to yield a profit to those who established them. If so, few better openings for practical benevolence seem to exist than the multiplication of appliances of this sort under prudent and careful direction, and I wish the subject may attract the attention of philanthropists.

Returning to the question of cheapening baths, let me remind the Congress that a practical attempt to bring a thorough bath within the reach of the million—that is to say to give a good warm bath for a penny—was described by Mr. C. C. Walker, of Lilleshall, at the Worcester Congress of this Institute. I have had an opportunity of visiting Mr. Walker's baths this summer, and though I shall not attempt to reproduce his technical description, which is already in print in your transactions, I will,

with your permission, briefly describe what I saw. In a modest, but perfectly neat, clean, and quiet brick building put up for the purpose, I found a range of small bath-rooms, each 8 ft. by 4 ft., all opening out of a paved corridor. Entering one of these the would-be bather, who is probably out of the adjoining foundry, and black with the dirty work he carries on there; or perhaps a still more grimy collier, from one of the neighbouring coal-pits, finds a capacious inviting-looking circular pan near the ground at the back of his compartment, and two taps, one of cold and one of hot water, and a stool, soap, flannel, and brushes, all ready for his use. He is directed, after undressing, to half fill this pan, with the warm and cold water laid on, to the warmth that suits him, and then to give himself a regular good wash in it. When he has soaped, and splashed, and rubbed to his heart's content, he can stand up in the pan, where close above him is a large copper rose. Pulling a chain, marked warm, a shower of light warm spray gently descends, and streams over his shoulders and chest, or head if he likes for it is mild and harmless. Another pull enables him to mix cold with the warm, and it is recommended to the bather, after thus cooling himself down, to finish off with a cold spray. This arrangement, simple, sensible, and pleasant, has been found immensely popular among the foundry men, and they have admission at a rate that is almost nominal. The outside public are admitted to this bath, which may be appropriately termed the Walker bath, and described as a "soap and spray bath," for a penny, this entitles the bather to a towel, but a piece of soap is a halfpenny extra. Mr. Walker believes that this penny fully meets the expense of his bath, but then there are exceptional circumstances in his favour, both as to initial cost and working cost. However that may be, there is no doubt that a soap and spray bath of the Walker type can be given more cheaply that a slipper bath, especially if it can be combined with some other establishment as, for example, a swimming bath. The points in its favour are that it affords an opportunity for a thorough good cleansing wash; that it consumes much less water than a slipper bath (the usual quantity used being found to be about eight gallons of warm water and a smaller amount of cold); and that considerably more baths can be given in a day. A slipper bath is usually detained half-an-hour by each bather, a Walker bath only twenty minutes; so that in a day of, say ten hours, thirty of the baths could be given in each bath-room as against twenty of the former.

Persons who manage warm baths, have constantly on the women's days, applications from women who bring two or

perhaps even three young children, and desire to give them a good wash, usually stipulating that they shall have only to pay for one bath though they occupy a bath-room a long time. For this kind of family bathing, Mr. Walker's bath seems particularly well adapted.

It appears to be not too much to hope that these appliances may be introduced into the humbler class of private houses, where a slipper bath would be rather too elaborate and expensive. A bath closet eight feet by four, floored and lined with Portland cement could be easily constructed and takes very little room, the pan, the spray, and the cistern to supply the warm water are simple, and a simple circulation of hot water either from the kitchen range or from a small tubular boiler and stove for the purpose, is not very costly, and the whole would afford the opportunity of a healthy and a pleasant bath in many a house of moderate pretentions, which will be occupied by artizans or persons a little above the artizan class.

This perhaps is looking ahead; at the present moment it may interest the Congress to know that an experimental trial is about to be made of a few of Mr. Walker's baths in London. The Carpenters' Company, which has a large estate at Stratford, in the East of London, upon which many hundreds of working people reside, has erected, mainly for their advantage, swimming and warm baths, which have proved a most encouraging success, as they have been through all the temperate and warm part of the year largely frequented. To these a few baths, as closely copied in every detail from those just described as possible, are now being added under my superintendence. The apparatus now being put up for us I have every reason to hope will work as successfully as in Mr. Walker's own establishment. We hope to be able to offer these baths to the public at a very low rate; and though as a novelty they may at first be distrusted, my belief is that they can hardly fail to become liked, for I know of nothing so well adapted to the requirements of working men.

Mr. Walker's plan is not, however, the only one that must be brought under your notice, nor do I claim for it that it is the best cheap bath for all classes and under all circumstances.

In the German barracks a spray bath is adopted which is the invention of Mr. David Grove, an engineer, holding a government appointment in Germany. This is minutely described in a pamphlet, for a copy of which I am indebted to Mr. Jennings. The essential points in this invention are that a large cistern is fixed at a level considerably above the floor of the bath-room, and simple means are provided for warming the water in this cistern and maintaining it at a temperature of 95°. A series

of open bathing compartments, each 3 ft. 3 in. wide and 5 ft. 8 in. high, occupies the middle of a large room. The men undress at the sides of the room, and enter the compartments in detachments. In each compartment is a spray fed from the warm-water cistern, and all are turned on at one time and shut off simultaneously. The sprays are oblong, perforated with fine holes and fixed slanting, at such a height and at such a slope that the jet of spray falls on the neck or shoulders of the man standing in the compartment, and not direct on his head unless he bends down for the purpose. The spray is continued for 3 to $3\frac{1}{2}$ minutes; and it is stated that with 18 bathing cells 300 soldiers can be bathed in an hour, and that the quantity of water consumed for each man is 15 to 20 quarts. The men are required to take soap with them and use it. It is claimed that this arrangement is well adapted for public institutions, schools, &c., as well as for army use; and I understand that it has been more or less employed in such places in Germany.

Another spray-bath has been of late introduced, and has been found successful. It has recently been stated that the late Sir Edwin Chadwick advocated something of the sort, and that Messrs. Doulton constructed an apparatus; but the spray bath that I now refer to seems to be due to the ingenuity and skill of Mr. E. A. Reynolds.

As I have seen it, the bathing apparatus is contained in a kind of cabinet of sawn slate about 2 feet 6 inches square and 7 feet high, with glass doors. The bather, on entering this and pulling the proper string, finds a number of fine jets of warm water directed on him from the sides, the floor, and from the ceiling. He can control the temperature of the jets; and when they have played on him for sufficient time, he shuts off the spray and withdraws. It will be seen that here, as in the German plan, there is no *tub*, and that no soaping will be easily possible, so that probably the bath, which is said to be extremely enjoyable, will be popular with people whose pursuits do not cover them with dirt and dust. One, if not more, of these spray-baths has been fixed by Messrs. Marshall and Snelgrove in the house where their young men reside, and that is exactly the sort of situation for which it will be best adapted. The water consumed for one bath is said to be, as a rule, three to four gallons, and the bather does not remain long in the compartment.

It will be manifest that the spray bath pure and simple, is pretty sure to be more economical of time and water than the soap and spray bath, and there are some situations where this economy is of importance and will turn the scale in its favour. But for operatives who want a thorough wash, and to have that

wash in quiet and comfort, the Walker soap and spray bath seems by far the best hitherto introduced, and it will I trust meet a real want.

My intention is not, however, to advocate any one plan, still less to assert that the limit of improvement has been yet reached, but to point out that the means of putting a good bath within the reach of that large section of our community, who can only afford to pay the lowest price, are actually at our disposal. There are none of our fellow subjects who more need a bath, or will be so much benefited by being able to obtain one. If we can largely extend to them and others the means of cleanlines, we shall promote health, decency, comfort, and self-respect, in short, sanitation in its most comprehensive sense.

It is time to draw these observations to a close. A well known proverb says, "Cleanliness is next to Godliness," and I hope my hearers will not think that this proverb has so sunk into my mind that I have been betrayed into a sermon instead of a scientific discourse. Pardon me if this has been the case, but agree with me if, in conclusion, I repeat that cleanliness *is* at least akin to godliness; and, permit me in closing to quote a few apposite words from a paper of racy personal recollections of the Sage of Chelsea, from the pen of his friend Emerson, who says that: "In the decay and downfall of all religions Carlyle thinks that the only religious act which a man now-a-days can securely perform is to wash himself well."

Sir Thomas Crawford (London), in proposing a vote of thanks to Professor Smith for his paper, observed that the subject was one which was directly connected with the health and welfare of the people. With regard to public baths, he called the attention of the authorities of Brighton to what appeared to be a want in their town. Brighton, he allowed, was well provided with public baths, and its sanitary committee was anxious to make them conveniently accessible to the public; but the expense attending one class of baths, at least, was prohibitive to certain of its visitors and inhabitants, and he thought that the complaint which had been made to him in this respect in a letter from a lady was deserving of the sympathy of the public. This lady was an invalid, writing from her bed, and she wrote that, living as she did—on a small pension—she could not afford the expense of the sea-baths which her health demanded; nor was she the only person feeling the want of cheap warm and cold sea-water bathing. She suggested that some of the apartments on the sea-front might be used for this needed purpose. Whether this

could be done or not, he sincerely hoped that Brighton would keep before them the example of the Romans, and that before many years elapsed the town would be celebrated as much for the cheapness as for the excellence of its baths—the public being able to get either warm, tepid, or cold sea-water bathing as they might require. Indeed, sea-bathing he held should be one of the main attractions of Brighton.

Alderman Dr. J. Ewart (Brighton), in seconding the vote of thanks, said that he felt that the paper was one which deserved the special attention of the Brighton authorities. Not that Brighton had been backward in its private and public bathing arrangements, for they had both swimming and slipper baths for the well-to-do portion of the community, whilst for the public at large they had two large bathing institutions at very cheap rates. He was happy to say that the older of these two bathing places was a very handsomely-paying concern, whilst the second, opened two years ago, was so rapidly increasing in demand that there could be no doubt that that also would shortly prove highly remunerative. With reference to the suggestion made by the President of the Congress, he might say from recollection that the subject of providing cheap sea-baths for the people had more than once been under the consideration of the Baths' Committee of the Town Council, and he felt certain that this evident demand would be adequately met. Then there was another suggestion made by Professor Smith with regard to the provision of swimming-baths for Brighton; that subject had entered largely into a paper read already by himself to the Congress. He believed thoroughly in the need of such an establishment, for it was necessary in all towns that the people should be taught to swim, both for their own safety and also on sanitary grounds; indeed, he relied more on this form of bathing than on the elaborate but rather effeminate institutions which existed in ancient Rome.

Mr. Charles Rosher (London), in reply to Professor Roger Smith's demand for greatly increased facilities for public bathing, suggested that the School Boards should take the matter up, and build baths in connection with schools, making swimming a compulsory part of the children's physical training, and that baths so established should be available for general public use between stated hours, on payment of a small fee, which would assist in making them self-supporting.

The vote of thanks was carried by acclamation, and Professor Roger Smith, in reply, remarked that he should be glad if anything he had said served as a suggestion for popularising baths either in Brighton or elsewhere.

On "*The Brighton Waterworks*," *by* Alderman W. H. Hallett, F.L.S., J.P., D.L.

ABSTRACT.

The Water supply of Brighton is obtained from a depth of 150 feet below the surface; the water is pumped into elevated reservoirs, varying in heights, for the purposes of convenient distribution—so constructed as to be closed against the action of light and of atmospheric influences, and containing large bulks of 1,000,000 gallons and upwards, the water in them constantly changing.

On the Southdowns, which environ Brighton for an area of sixty or seventy square miles, no lakes or rivulets are seen. The sub-soil is in general that of the upper chalk formation with flints. The two rivers, the Adur, five miles west, and the Ouse, eight miles east, which flow through the hills, serve as the drainage of the Weald, not of the Downs.

Explorers in the chalk find fissures through which pass rivulets and rills seawards, and below low water mark on the seacoast fresh-water springs find their way out.

Formerly wells were sunk in the chalk formation with an uncertainty as to the result, very like that which is still experienced by those who dig in the Sand Rock.

In 1830 an effort was made by a Company to secure a systematic supply to the town of Brighton, and their first well was sunk in the Lewes Road. The water was raised by steam power to a reservoir 220 feet high. The supply being easily pumped out, to increase it tunnels were driven in the form of a cross, also to serve as a storage to pump against. A boring was also tried to a greater depth, but without beneficial result.

In 1852, consequent on great complaints of the inadequate water supply, a new Company replaced the first, with powers to carry out extensive works, and also undertaking to give a "constant" service supply.

This duty of giving a "constant" supply the Company afterwards desired to be relieved of, but were unsuccessful. They found that although only 7,000 services were connected with their system (hardly half of the then existing houses) that their supply was quite inadequate. They sunk a well at Preston, on the east side of Miller's Hill, hoping thereby to catch water coming from the upper part of the valley of Patcham, but

without good result. The Patcham water was found to draw to the east, and the tunnels at Lewes Road being extended to their western limit, intercepted some of this supply of the Patcham springs.

The Directors then called in Mr. James Easton, who had successfully secured water for the supply of Ramsgate, built on the chalk formation of the Isle of Thanet.

Mr. James Easton's method of cutting across the fissures is that which is acted on in all the water stations of the Corporation.

He had ascertained and proved that where the stratification of the chalk has not been disturbed by upheavals or depressions, the fissures, which are the water conduits, are found to be at right angle (or thereabouts) with the coast line.

Each fissure contains a small rivulet, beginning at the supersaturation of the chalk, and flowing on and collecting more water as it proceeds.

The sides of the fissures are coloured by infiltrations of particles of the upper clays.

The fissures are seldom more than a few inches wide, generally not one inch. Hence there is considerable resistance to the passage of the water. At a distance from the outlet, the water stands higher and higher in the wells as the distance increases, as was shewn by Mr. Edward Easton, C.E. (with diagrams) in his paper on these waterworks read at the Brighton Health Congress in 1881.*

In an earlier paper, read in August, 1872, at the meeting of the British Association in Brighton, Mr. Easton stated that the maximum of water in the chalk is generally in the month of March, and the minimum in the months of October, November, and December. From diagrams of curves then shown by him of the varying depths in the wells, the supply appeared to reach them in three and a half to four months after rainfall. He concluded that the chalk acts as a storage-reservoir in retaining the usually heavy rainfalls of the months of October, November, December, and January, during which time evaporation is least in operation.

Up to 1865 the whole supply of the Company was drawn from the Lewes Road Works, when the Directors began to prepare for a new and independent supply to meet a growing and an expected increasing demand. They then commenced at Goldstone Bottom, on the west side of Brighton.

In his paper (August, 1872), Mr. Easton stated that there

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* Transactions of the Brighton Health Congress, 1881, page 48.

were two distinct sources of supply, each sufficient to give a maximum supply. That there were three sets of engines, each equal to the delivery in twenty-four hours of the then maximum demand, and that there was storage capacity in the reservoirs equal to two days' supply. There were then 18,000 services connected, of which 5,000 were on the "Constant" service. The tunnels in Lewes Road were 2,400 feet in length, and those at Goldstone were 1,300 feet in length. The town was divided into four zones, served from "Low," "Middle," "High," and "Higher" Reservoirs.

This answers as a stock-taking account of what the Corporation obtained for their purchase on acquiring the control, 1st July, 1872.

In 1871 the Corporation gave notice of their intention to apply to Parliament for a Bill to enable them to purchase the Waterworks compulsorily. When the Bill was deposited the Company's solicitor represented that the Directors would fight the "compulsory" clause, but would concur in a clause for purchasing by agreement.

The terms arrived at were quite as moderate as would then have been imposed by a Parliamentary Committee, and were satisfactory to all concerned in the sale.

The Waterworks Committee was appointed in July, 1872, and chose Alderman Ireland, Chairman. In June, 1874, an outlay of £30,500 was voted at once, involving a new charge on income of £1,600 a year. This provided a duplicate engine at Goldstone, costing £16,000, a new middle reservoir for the west, new mains, and also a liberal sum for driving tunnels. The droughts of 1873 and 1874 made this feasible, and by November 1st, 1874, great extensions had been made. On that day an exceptionally large fissure was opened at the foot of the entrance well, driving the men up hastily, and no further work was admissible for several years.

With the best will to do everything necessary or desirable the Corporation would not have succeeded as they have done in eighteen years, but for good and energetic advisers. From Mr. Edward Easton, C.E. (son of Mr. James Easton, already named) they have had such plans submitted from time to time as have served to keep every part of the great undertaking well up to the mark. By their local engineer, Mr. John Baker, works of very arduous character have been carefully executed, and he has now the entire responsibility for carrying out the new pumping-station at Patcham.

In August, 1872, the Chairman, Alderman Ireland, informed his committee that he had authorised discontinuance of pumping at Lewes Road for a few days, so that all the town supply

was worked by the ONE engine at Goldstone. The object was to allow of a visit to the tunnels by a party of the British Association, then meeting in Brighton. Professor Fawcett, M.P., was amongst those who made the descent. Now, in 1890, to enable your members to inspect the tunnels (in the same month of August), TWO engines have worked night and day for four or five weeks, and an intermission of two or three hours pumping would leave the water over the banks and impassable, so that no visit could be made.

The method hitherto pursued has been to sink the tunnels as nearly as can be to sea-level. It has been long known, however, that the chalk-fissures go much lower, as some have been plumbed 150 feet without finding bottom. Mr. Baker, after very extensive workings, is of opinion that, if an opportunity offered, there might be intercepted below that level, great supplies which are now escaping seaward. That subterranean conduits are at work at lower depths, and most probably finding an outlet under the sea, seems to be shown by the Warren School well, which was dug to a depth of 1,285 feet before meeting with water—or 700 feet below sea-level. When water was found it rose to about 100 feet above sea-level; pumping for seven hours at the rate of 8,000 gallons per hour, lowered it 13 feet. Apparently, the source of supply was not strong. The water was not from the chalk, but from the Lower Green Sand. The nearest Green Sand formation is a narrow belt on the north side of the Southdowns. If that was not the source of the Warren well, the next possible source would be the Reigate Sands.

The break-down of machinery, through which the Corporation obtained control, naturally kept that subject prominent in the minds of the Waterworks Committee, so that they were sensitive in any delay in repairs. Not long after they had control a delay occurred, and it was at once resolved to have as much as possible done locally. The Committee were fortunate from the first in having one of its members, Mr. John Chester Craven, C.E. (for years Locomotive Superintendent of the London, Brighton, and South Coast Railway Company), eminently able to give engineering counsel, and in 1882 he strongly advocated Mr. Baker being allowed, as he himself desired, to have works of his own to do repairs. The mechanical appliances have been gradually added to, and the Committee have every reason to be satisfied with the results of their expenditure for plant, now reaching upwards of £2,000. With it Mr. Baker turns out every subsidiary part used—pistons, buckets, &c., &c. He informs me that, with the plant he now has, he could furnish a 50-H.P. or even a 100-H.P. engine if

ordered. Duplicates are always on hand ready to promptly replace any part.

I have referred to Mr. Easton's stock-taking in 1872, and to the £30,500 passed by the Council in 1874 to carry out all that the Directors of the Company had had under consideration. The Corporation paid £350,000 for what they bought, and their capital debt is now £500,000. One hundred and fifty thousand added in eighteen years (inclusive of the £30,500 just named), and what is there to show for the new outlay? The first step was to devote grounds at Lewes Road Station, and build greenhouses at a cost of £1,000 for the head gardener, who supplies therefrom all the plants required by the Recreation-ground Committee. High, middle, and low reservoirs now exist on each side of the town, intended to balance each other, so that water pumped at one side can transfer to the other, and great mains have been re-arranged and relaid for that purpose. The fire-mains have been materially improved in their force everywhere. The constant-service main is everywhere. The Corporation have striven energetically to induce its use, and at the end of 1889 there were 18,812 constant, against 6,893 which are still intermittent, or 73 per cent. of "constant" service connections. In 1872 there were less than 28 per cent. connected. It is hoped that the remainder will come in more rapidly under the pressure of good example, but the cost of changing the pipes in a house to be adequate for the greater pressure from the public reservoirs deters many. The capital has increased 33 per cent., and the revenue from £24,000 to £42,000, or 75 per cent. There is a gradually-increasing margin of profit notwithstanding so much more is supplied by the constant service, and although the Corporation supply water for street flushings both in Brighton and Hove (which may be counted in millions of gallons in the year) without any charge whatever; while the Company never supplied water for public uses without charges.

There must also be included in the £150,000, the purchase of the West Brighton Waterworks (£15,000), and the preparations for a station at Patcham, £10,000.

Nothing can better demonstrate the superiority of the present mode of seeking for water in the chalk than comparison with what the Directors of the Company did before the system was known. They actually dug in the Patcham Valley for water and relinquished their attempt, while the Corporation from 1883, and without fear of any failure, deliberately go to the same Patcham Valley for their third supply. To the works at Goldstone this better state of knowledge is owing, and to Mr. Baker's keen appreciation of the state of water

affairs near Patcham tunnel may be attributed Mr. Easton's report in favour of a new station there.

A visit on the 6th of December, 1884 (after the Healtheries Exhibition), of engineers representing great London water companies was made to the Goldstone tunnels. Sir Francis Bolton and his colleagues of the East London Company left them intending to adopt a similar system—2,000 feet have been tunnelled already.

Mr. Baldwin Latham (London) reminded the Section that for the last fifteen years he had been carrying on over the chalk districts of England observations on underground water. He asked if any survey had ever been made of the area which contributed the water supply of Brighton? In many towns the water-works were located with very small consideration to their surroundings, and in many instances water-works had been constructed which had proved an absolute failure. At Caterham well after well had been sunk without any success whatever in getting an adequate supply of water. They had been so sunk on high ground that it was like endeavouring to collect water at the top of a spire. So unsuccessful had their previous efforts proved that the Caterham Water Company had had to buy up another water-works, and now from a lower point in the valley they were sending back water to Caterham to be softened and distributed. It was important both from a sanitary point of view and from the view that the works themselves should be adequate, that before undertaking the construction of water-works local authorities should have an accurate knowledge of what quantity of water they were likely to get from the site selected. He thought that the question of water supply was much more important from a public health point of view than even drainage works. The fluctuation of water was shown in the death rate of children, and the mortality of a district might be easily and correctly estimated by taking the deaths of children under five years of age, and comparing them with the exact fluctuation of underground water. The lower the water the higher the death-rate would prove. There had not fortunately been any very low water since the periods of 1854, 1864, and 1874 (that of 1864 was the lowest), and he thought if they ever got into such a low state again it would prove a true test of the value of their several water-works. He was sure the Corporation of Brighton were to be extremely commended for having seized an opportunity to get absolute control of the water supply. It was very unfortunate for any town to have two services (intermittent and constant), and he would have all intermittent supplies abolished. It would prove to their advantage to do so, and it would be found to be true economy. Indeed, there was nothing to gain but everything to lose by continuing intermittent supplies. More water was used in intermittent than in constant

services, and it would be a great advance for the constant service to become general in Brighton. There was no decrease in a volume of chalk by reason of the solvent action of water; in fact, this action was extremely slow, and it was only to the depth of the first fifty feet that any change took place. One effect of rain was to saturate only the upper layers of chalk, and that was why in chalk water they always found a uniform quality. Moreover, the quantity of water absorbed by chalk was comparatively small—of rain about one-third only going into the chalk. Chalk water had a low temperature, but when it was distributed this was different. The temperature supplied to the town was the temperature of the ground where the mains were laid, and if they took the temperature of water from any drinking fountain in Brighton, they would find it very different from that found in connection with water in a well, whilst it would be very much the same as that taken from a drinking fountain in London. To the increase in the temperature of drinking water he attributed summer diarrhœa, and if they wished to keep this temperature down they must lay their mains at a considerable depth. It was advantageous for Brighton to have its reservoirs close to the town, but if the water had to pass for a mile or a mile and a half through water pipes the temperature was sure to get high. He was much interested himself in the question of Brighton water supply, and he felt very indebted to Alderman Hallett's valuable paper, for every one of the records it contained added greatly to the value of engineering literature.

Mr. R. F. Grantham (London) directed his remarks to the additional stores of water found below the level of the sea, and gave his experience of wells sunk by his father and himself at Littlehampton to corroborate Mr. Baker's statement that large quantities of water were to be found below the sea-level. It is becoming the custom now, he added, not to soften chalk water; the new waterworks at Croydon supplied their water from a chalk well, but did not soften it at all.

Alderman W. H. Hallett (Brighton), in reply, explained that his remarks about chalk becoming more porous were taken from a report to the Royal Commission, whose members, it might be admitted, held views which were not accepted now. To his knowledge no complete survey of the area which contributed to Brighton water supply had been made. He would mention in a general way that it extended as far as the Dyke, and that they were overburdened with water, for the supply was double what was consumed; under these circumstances, there was no likelihood of Brighton having yet awhile to go below the sea-level for its water.

On "Water Works Regulations," by Reginald E. Middleton, M.Inst.C.E.

The subject on which I have been asked to write is that of Water Works Regulations with regard to their bearing on sanitation.

I have obtained copies of regulations from some twenty-two corporations and companies in about equal proportions.

Most of the corporations and companies provide their regulations in the handy form of small pamphlets, which bear throughout a general family likeness; and it is only in a very few cases when there is any marked departure from the general form, and this departure is for the most part in the direction of omissions.

I quote the Regulations of the Liverpool Corporation Water Works *in extenso*, as being, perhaps, as complete and simple as any others.

1.—Persons requiring a supply of water must fill up, sign, and deliver a form of application, to be obtained at the Water Engineer's Office, and pay to the Treasurer a sum equal to one quarter's water rent, also a deposit (the amount of which will be stated when the application is presented), on account of any piping or fittings which may have to be furnished or laid for the applicants by the Water Committee.

2.—Such persons must, at their own cost, provide, lay down, and maintain all service pipes and fittings which may be required within their premises, and one foot of pipe beyond the boundary thereof; and in the case of all premises situated outside of the Borough, or of supplies for other than domestic purposes within the borough, they must also pay the cost of providing, laying, and maintaining the piping and fittings necessary to form a connection with the main, which work will be done on their behalf by the servants of the Corporation.

3.—The Corporation will publish on their Water Rent Papers, on the Waste Water Notices, and in such other manner as they may from time to time consider necessary, the names and addresses of such plumbers as they may approve of, who undertake to execute work in accordance with the following Regulations; and such plumbers will become responsible to the Corporation for the proper execution of all work done by them, and before they are placed on the list will sign an agreement accordingly. If they fail to comply with the requirements of the Corporation, their names will be struck off the list.

4.—All fittings used in connection with a supply of water must be tested and stamped by the duly authorised officer before being fixed, and the following Fees will be charged:

Bib and Stop Taps	2d. each.
Ball Taps	3d. „
Closet Cisterns with Ball Taps	6d. „

5.—A set of standard fittings such as have been hitherto approved is exhibited in the Stamping Office; but the Engineer will give due consideration to the claims of any other fitting which may be presented for approval, and which, if considered satisfactory by the Committee, will be stamped, the sample purchased and placed among and become one of the standard fittings.

Before any fitting is withdrawn from among the approved samples, six months' notice will be given to the Master Plumbers' Association.

6.—Every service pipe hereafter laid or fixed below ground shall be of lead; and every joint on every lead pipe, whether below the ground or not, shall be of the kind called a plumbing or wiped joint.

7.—All service pipes laid underground must be at least 2 feet 6 inches below the surface, and must be brought out through the boundary of the premises 2 feet 6 inches below the surface of the street or roadway.

8.—Lead service pipes, for supplying water for domestic purposes, must be of the diameters stated below:—

For 1 house, not exceeding £20 per annum rateable value, $\frac{3}{8}$ inch diameter.

For 1 house, above £20 but not exceed £70, or for 6 houses, not exceeding £13 each rateable value, $\frac{1}{2}$ inch diameter.

For 1 house, above £70, or 14 houses not exceeding £13 each rateable value, $\frac{3}{4}$ inch diameter.

9.—No house or block of offices in the same building belonging to the same person, shall have connection with the pipes or other fittings of any other premises. Where two or more houses of a rateable value exceeding £13 per annum each are supplied from one cistern, a leading pipe from the cistern must be laid in the back passage, and separate branches taken therefrom into each house; and in all cases of blocks of houses, whether under or exceeding £13, supplied from one cistern, a by-pass pipe, with stop-cocks, must be placed in such a manner as to lead the water direct from the mains to the houses during periods of constant service.

10.—Lead pipes shall be of not less than the following weights per lineal yard:—

PIPES IN THE UPPER DISTRICT AND IN THE LOWER DISTRICT IF SUPPLIED FROM A CISTERN.

$\frac{3}{8}$-in. dia	$4\frac{1}{2}$ lbs. per yard.	$\frac{3}{4}$-in. dia	8 lbs. per yard.
$\frac{1}{2}$ „	5 „ „	1 „	11 „ „
$1\frac{1}{4}$-in. dia	13 lbs. per yard.		

PIPES IN THE LOWER DISTRICT UNDER PRESSURE FROM THE MAIN.

$\frac{3}{8}$-in. dia	$4\frac{1}{2}$ lbs. per yard.	$\frac{3}{4}$-in. dia	11 lbs. per yard.
$\frac{1}{2}$ „	7 „ „	1 „	15 „ „
$1\frac{1}{4}$-in. dia	18 lbs. per yard.		

Any lead pipe of which the end is open so that it cannot remain charged with water, may, however, be of the weight given in the following scale:—

$\frac{1}{2}$-in. internal dia	3 lbs. per yard.	1-in. internal dia	7 lbs. per yard.
$\frac{3}{4}$ „ „	5 „ „	$1\frac{1}{4}$ „ „	9 „ „

11.—Pipes of any other metal than lead shall only be fixed after samples thereof have been submitted to and approved by the Water Committee.

12.—No pipe shall be laid through, in, or into any sough, drain, ash-pit, manure-hole, or other place from which in the event of decay or injury to such pipe, the water might be liable to become fouled or to escape without observation, or without occasioning the necessity for immediate repair.

In any case in which any such sough, drain, ash-pit, manure-hole, or other place as aforesaid, shall be in the unavoidable course of the pipe, such pipe shall be passed through an exterior cast-iron pipe, or box of sufficient length and strength to afford due protection to the water pipe, and to bring any leakage or waste within the means of easy detection.

13.—No pipe shall be brought above the level of the ground outside any building, except for the supply of an outside tap in a yard, in which case the pipe shall be properly protected from frost by brickwork, or otherwise, and encased in felt, or other non-conducting material, to the satisfaction of the Engineer.

14.—Every separate service-pipe must be provided with a stopcock and box which will be fixed outside the private premises by, and in cases of domestic supplies within the Borough at the expense of the Corporation.

15.—A tap shall be placed in each house, on the leading pipe from the main, in order that water may be drawn for drinking and culinary purposes without passing through the cistern.

16.—Storage cisterns must be provided for all domestic supplies. Where there is a bath or hot water apparatus, the cistern must hold not less than 50 gallons for each house. In other cases, not less than 25 gallons for each house.

17.—Cisterns for the storage of water (not including water closet and urinal regulating cisterns) shall, if of wood, be lined with lead of not less than 5lbs. to the square foot. The iron, wood, or slate work shall be strong and well put together, and each cistern shall be provided with a ball tap which must be securely fixed to the side thereof, and it must be in such a position as not to become submerged when the cistern is full, and the level of the water at such time shall be three inches below the overflow.

18.—Domestic boilers, water-closets or urinals must in all cases be supplied from cisterns. All cisterns for the supply of water-closets or urinals shall either be on the alternating valve principle, and so constructed as to be capable of delivering two gallons at each flush, which must be discharged within 15 seconds, or otherwise so arranged as to produce the same result in an equally efficacious manner; but no valve except the ball cock shall at any time have a greater pressure upon it than that due to the head of water in the cistern.

19.—Overflow pipes of cisterns or other receptacles for storing water shall be not less than $\frac{3}{4}$-inch internal diameter, and wherever the level of the cisterns will admit of it, they will be brought to conspicuous points above the ground on the outside of the building containing the cisterns, in such a manner as to act as warning pipes, but in no case shall they discharge over the ashpit. Where a cistern is too low to admit of this, the overflow pipe shall be fixed in such a position as shall be determined, in writing, by the Engineer.

20.—No pipe for the conveyance of, or in connection with, water supplied by the Corporation, shall communicate with any cistern or other receptacle used, or intended to be used, for rain water.

21.—No cistern for a domestic supply of water shall be built or placed under the surface of the ground.

22.—Every cistern shall be in an accessible position, and made capable of easy inspection.

23.—Where a cistern is fixed in an exposed position it must be bricked around, or otherwise encased and covered, so as to prevent, as far as practicable, the action of frost upon the water.

24.—The pans or basins of all water-closets, not of the trough kind, must be of a semi-circular shape, or of such other form as can be most efficiently flushed; the down pipe from the cistern to the basin of the closet must be of not less than $1\frac{1}{4}$ inches in diameter, except in connection with pan closets, where the head of water exceeds 8 feet, when the down pipe may be of 1 inch diameter. In the case of pan closets, the metal pan shall be capable of bearing a weight of 7 lbs.

25.—The detail arrangements of all trough closets shall be submitted to, and approved of, by the Engineer before such closets are fixed.

26.—Every bath must be provided with a well-fitted and perfectly water-tight ground outlet plug, with chain complete, or such outlet tap as shall be entirely independent of the inlet.

27.—None but screw-down taps, incapable of being suddenly closed, shall be fixed on pipes supplied direct from the main.

28.—Any standpipe fixed for the use of the occupants of more than one house must be fitted with a self-closing apparatus incapable of being suddenly shut.

29.—The Corporation will provide and fix all water meters for the supply of water for trade purposes, and will also lay the service pipe from the boundary of the premises to the inlet of the meter, and fix the stopcock thereon, at the expense of the occupier of the premises.

30.—No steam boiler, or any description of closed boiler, will be allowed to

be supplied direct from a service pipe; but the supply will be given through a meter, and a self-acting check valve must in every case be fixed on the pipe, so as to prevent a return of the water.

31.—Hydrants for fire or other purposes inside premises can only be permitted by the special sanction of the Water Committee, for which application must be made in every case.

32.—Before a connection for the supply of water can be made, or before any additional fittings can be connected to an existing service pipe, the work must be inspected and approved by the proper officer of the Corporation.

33.—Printed forms will, upon application, be furnished to plumbers who have signed an agreement to conform to the regulations, which they will be required to fill up and deliver at the Engineer's offices, as notices of fittings being ready for inspection, and also of any alterations made in existing service pipes or fittings, and such notices must be given before pipes or other fittings are covered.

Instructions to Plumbers as to Repairs of Defective Fittings.

All existing fittings which are so far defective that they cannot be effectually repaired to the satisfaction of the Engineer, must be replaced by stamped fittings, in all respects in conformity with the preceding regulations.

The attention of Plumbers is directed to the following special cases:—

Any single valve regulating cistern, if found to be causing a waste of water after having, on a former occasion, been repaired on account of waste, shall, if the two periods of waste have occurred within twelve months, be replaced by a stamped cistern.

Common cocks (whether bib-cocks, stop-cocks, lever-handled, or weighted cocks) to water-closets when found to be wasting water, or left open through carelessness, must be replaced by stamped cisterns.

Whenever a leakage arises in, or repairs have to be effected to a ball-cock, in a cistern of which the overflow is connected with a drain or flush pipe, the existing overflow must be cut off and brought to the outside, in accordance with regulation 12.

Such underground cisterns as may cause unseen waste shall, if found to lead to waste in any case, be abolished.

George F. Deacon,
Municipal Office, Dale Street. *Water Engineer.*

Notice to Plumbers.

As there appears to be some misapprehension concerning the operation of the Regulations of the Corporation in regard to By-Pass Pipes, Overflow Pipes, and Cisterns, the following explanations are issued for the guidance of Plumbers:—

As to Regulation No. 9—By-Pass Pipes.

In all cases where two or more houses are supplied from one cistern, and there is no tap supplied direct from the main, a connection must be made between the inlet and outlet pipes, so that during periods of constant service the water may flow direct from the main to the inside pipes. This may be done in one or two ways:—

(a) By a pipe joining the inlet to the outlet pipes, and provided with stopcocks to enable the water to be turned either into the cistern or direct into the outlet pipes without entering the cistern.

(b) By a pipe joining to the outlet of the ball cock, and to the outlet of the cistern by means of brass unions; the union at the outlet to have a lock nut. A sketch of this arrangement will be shewn on application at this office. Ball cocks specially adapted for the purpose will have to be provided, and must, together with the unions, be stamped by the Corporation Testing Officer.

All pipes and taps used in houses where the by-pass arrangement is applied, must be of the kind required for direct communication with the main.

As to Regulation No. 19.—Overflow Pipes.

Overflow pipes must not be laid into back yards or on to roofs, but must be brought to the outside of the premises to which they belong, in accordance with Regulation No. 19.

No departure from this regulation will be allowed without permission being given in writing.

As to the Fixing of Water Closet Cisterns.

Numerous cases have been reported where water closet cisterns, in new houses, have been fixed on single bearers, and the covers have been allowed to rest against the walls of the closets. This arrangement is objectionable. The cisterns should be firmly supported, and set in a level position without being supported by the walls of the closets. The covers should be screwed on when the cisterns are properly fixed, and should be capable of easy removal.

As to the Covers of Storage Cisterns.

Regulation No. 22 requires every storage cistern to be "made capable of easy inspection." To carry out this regulation the cover of every large cistern should have an opening over the ball cock with a lid, fastened with screws, so that it may be readily removed to examine the interior of the cistern and ball cock without removing the large cover.

George F. Deacon,
Water Engineer.

It is to be specially noticed that in many cases the authorities state that only such plumbers as are certified by them shall be employed by the consumers, and I am informed that in one case where a plumber had been suspended, he attempted, by action at law, to obtain a reversal of his suspension, but that this action on his part was successfully resisted. How far this procedure is really authoritative I am unable to state. In most cases the authorities content themselves with publishing a list of plumbers who have signed an agreement with the Corporation or Company, by which they bind themselves to adhere to the Regulations on pain of having their names struck off from the list of authorised plumbers if they neglect to do so; but in these cases the Corporations and Companies do not appear to consider that they have any right to insist on the employment of the plumbers whose names appear on these lists, and these only.

It seems most desirable, in the interests of the consumer, as well as of the Water Company, that only reliable plumbers should be employed, and if the Company has power to make regulations as to the supply of water, and to refuse to afford such supply unless certain conditions are complied with, one of these conditions may reasonably be, that only plumbers who agree to work in accordance with certain regulations, and who will be responsible for the excellence of their work, shall be employed; it does not appear, however, that such exclusive employment is insisted on in the majority of cases, though it is strongly recommended.

4. All fittings must be tested and stamped. This is a general, but by no means universal requirement; in many cases it is

stipulated that the valves and other apparatus shall be approved by the Company; in some instances no stipulation whatever is made on this head. It seems desirable that water fittings should be of the best quality, and that each fitting should be stamped by the water authority, who should be responsible for its workmanship, and for its fitness for its purpose. It would probably be more convenient still if each Corporation or Company were to supply these fittings at trade prices; but this practice might have a tendency to stereotype designs, and to prevent the introduction of new and improved patterns.

5. A set of standard fittings is exhibited in the stamping office, and the engineer will examine any other fittings and decide whether they may be used or not.

This seems to be a universal provision when stamping is compulsory and is only just.

In the Glasgow Corporation Water Works Regulations, a list of dimensions of taps and fittings is supplied in the following form.

The taps must not be less than of the following weights and dimensions:—

	Size of Taps.				
	$\frac{3}{8}$-in.	$\frac{1}{2}$-in.	$\frac{5}{8}$-in.	$\frac{3}{4}$-in.	1-in.
Screw-down Loose-valve Nose-cocks & Stop-cocks	$9\frac{1}{2}$ ozs.	$12\frac{1}{2}$ ozs.	$16\frac{1}{2}$ ozs.	21 ozs.	35 ozs.
Diaphragm Nose-cocks and Stop-cocks..................	$10\frac{1}{2}$ „	14 „	18 „	23 „	39 „
Double-valve Nose-cocks...	$11\frac{1}{4}$ „	$14\frac{1}{2}$ „	$18\frac{1}{2}$ „	$22\frac{3}{4}$ „	
Screw-down Loose-valve Tube-cocks..................	......	......	27 „		
Diaphragm Tube-cocks ..	......	......	$28\frac{1}{2}$ „		
Outside diameter of tube	......	......	$\frac{9}{16}$ ins.		
Underground Stop-cocks— Weight	......	$24\frac{1}{2}$ „	......	35 „	54 „
Length of Cocks	......	$5\frac{3}{4}$ ins.	......	$5\frac{3}{4}$ ins.	$6\frac{1}{4}$ ins.
Ferrules— Weight	......	......	......	8 ozs.	$14\frac{1}{2}$ ozs.
No. of threads of screw to the inch..............	......	......	......	14	11
Stop-cock boxes, 8 in. high. Weight	......	......	28 lbs.		

All taps must have the maker's name stamped upon them.

6. All service pipes shall be of lead and every joint shall be wiped.

Lead pipes are required by the majority of companies, and in a few cases these are specified to be tinned; in a few instances wrought-iron pipes are permitted, and in one or two

cast-iron pipes may be used; but wherever lead pipes are required wiped joints must be made.

7. All service pipes must be laid at least 2 ft. 6 in. below the ground.

This depth varies in different places from 1 ft. 6 in. to 3 ft.

8. Lead service pipes must be of certain dimensions. In this case the smallest pipe permitted is $\frac{3}{8}$ in.; most of the companies do not allow of a smaller diameter for a service pipe than $\frac{1}{2}$ in., and specify that where a $\frac{3}{8}$ in. pipe is used only one tap may be placed upon it.

9. That each house or block of small houses should have its own separate supply is an almost universal stipulation and a reasonable one.

10. This regulation provides for the weight per yard of the lead pipe used for supply—such weight varies with the pressure of water maintained in the mains. Pipes not under pressure may be of lighter weight.

12. Pipes may not be laid through any drain, &c., unless provided with an exterior cast-iron casing. This is a universal and necessary requirement.

13. No pipe shall be brought above the level of the ground outside any building, unless properly protected from injury and frost.

No exception can be taken to this regulation.

14. Outside stop-cocks are in this case fixed by the corporation. In many cases they are only recommended, and in others they must be fixed at the expense of the consumer.

It is, I should say, desirable that the use of stop-cocks should be compulsory, and that they should be fixed by and at the expense of the corporation or company.

15. The supply for drinking and culinary purposes shall be drawn direct from the main.

It is most desirable that this stipulation should be universal, but this can only be done by making constant supply universal.

16. Storage Cisterns. In the regulations of the Liverpool Corporation, where a bath or hot-water apparatus is used, the cistern must be capable of containing 50 gallons, in other cases 25 gallons. In many instances it is provided that cisterns to contain a day's supply shall be provided—which is a very indefinite term—in others, no provision is made.

17. Cisterns shall be strong, and if constructed of wood shall be lined with lead, weighing at least 5 lbs. to the square foot; the ball valve shall be securely fixed to the cistern, and shall not be submerged when the cistern is full, and the level of the water at such time shall be 3 ins. below the overflow.

18. Domestic boilers, water-closets, and urinals must in all

cases be supplied from cisterns. Such cisterns shall either be on the alternating valve principle, and capable of delivering two gallons at each flush in 15 seconds, or otherwise so arranged as to produce the same result; but no valve except the ball valve shall have a greater pressure on it than that due to the head of water in the cistern.

In many of the regulations it is provided that for closets and urinals water shall only be drawn from a two gallon cistern, whether separate from or attached to the main cistern; such supplementary cistern to be provided with valves, which shall not admit water to the cistern at the same time as it flows from it. No doubt this arrangement is the best for insuring that only two gallons of water shall be used at each flush, but unless the inlet to the cistern is of considerable dimensions, which is not usually the case, when the closet or urinal is used in quick succession on the second using the cistern is not full, and the closet or urinal is not sufficiently flushed.

19. Overflows from cisterns shall act only as warning pipes, they shall not discharge over any ash-pit. This provision precludes the use of a standing waste, or other arrangement by which the cistern may be readily emptied and cleaned, and it is preferable that a ground valve should be permitted in the bottom of the cistern, in order that it may be easily cleaned out, such ground valve to communicate with a rainwater head, and thence, but indirectly, with a gully.

20. No water pipe shall communicate with a rain-water cistern.

This regulation requires no comment.

21. No cistern for domestic purposes shall be placed below the surface of the ground.

This is a general specification.

22. Every cistern shall be in an accessible position, and made capable of easy inspection.

As here specified, this requirement can be met with facility, but when it is stated that every cistern must be securely covered, and must be easy of inspection, some explanation is necessary, and this is given in one or two cases, and the requirement is stated to mean that a good cover must be fitted to every cistern, and a small door provided in it by which access can be obtained to the ball cock. It must be obvious that such an arrangement as this makes it exceedingly difficult to clean the cistern, or to see if it requires cleaning.

23. Cisterns must be protected from frost.

24. The pans or basins of water-closets must be of a specified form; the flushing pipe, except in the case of pan closets provided with cisterns having a fall of at least 8 ft., must be

$1\frac{1}{4}$ in. in diameter; in the latter case they may be 1 in. in diameter, and in pan closets the pan must be able to sustain a weight of 7 lbs.

If closets are amongst the standard fittings which must be approved, as they certainly should be, this and the following clause, so far as closets are concerned, are useless; and if closets must be approved, any regulations with regard to pan closets might be omitted, as they ought not to be passed by any engineer.

25. Trough closets to be approved by the engineer.

26. Every bath shall be provided with a water-tight plug or valve unconnected with the inlet valve.

This clause is meagre and does not compare well with the requirements of many other places where it is specified that the inlets shall be above the highest water level in the bath, and that there shall be no overflow other than such as will act as a warning of waste.

27. None but screw-down or slow-closing taps shall be fixed on the main or pipes connected directly with it.

28. Any stand pipe used by more than one house must be provided with self-closing apparatus, incapable of being suddenly shut. This appears to be necessary in the case of any stand pipe, whether used by one or more houses.

The remaining clauses, Nos. 29 to 33, and the instructions to plumbers with regard to defective pipes and fittings, do not call for any remark, they appear to be common sense and reasonable requirements, though, considering the powers claimed, it might be expected that only water-closets of approved pattern would be permitted, and that direct connection between cisterns used for domestic supply and closets would be condemned.

The second instance of a series of regulations which has been taken to illustrate this paper, is that of the Chelsea Water Co., and forms a great contrast to the above. In the regulations of the Liverpool corporation there are thirty-three clauses besides instructions to plumbers with regard to defective fittings and explanatory notes, whereas in those of the Chelsea Water Co. there are only seven clauses, lettered from A to G, and corresponding generally with Nos. 17, 18, 19, 20, 21, and 26, and may be shortly summarised as follows:—

A. Every cistern shall be water-tight. Separate cisterns for baths, closets, and hot-water apparatus, are recommended.

B. Underground cisterns and wooden cisterns without metallic lining are not permitted.

C. Each cistern must be provided with a ball-valve, securely fixed to the side of the cistern, the highest level of water not to submerge the ball, and to be 2 ins. below the warning pipe.

D. No waste pipes are permitted other than warning pipes, which must not be connected with any drain.

E. Taps to be of the best screw-down kind, and in accordance with sample.

F. Water-closets and urinals must be supplied only through a cistern or service-box, or other approved waste-preventing apparatus. Stool-cocks and T taps are prohibited, and there shall be no direct connection between any closet and the Company's pipes.

G. The inlet of a bath must be distinct from the outlet, and it must be placed above the highest water-level in the bath. Every outlet shall be provided with a water-tight plug or valve. No bath shall have any overflow other than a warning pipe.

Where the regulations are full and explicit, although they are primarily directed to prevent waste of the Companies' water, yet they also act fairly, though not completely, as safeguards to the consumer from a sanitary point of view. This cannot however be said of the short and incomplete regulations —they are directed almost entirely against waste of water.

I may suggest that it would be advantageous if all regulations could be assimilated, with such slight modifications only as are necessitated by local requirements.

I append certain regulations of the Manchester Corporation Water Works which are worthy of consideration. Regulation No. 15, by which urinals may be flushed direct from the service pipe if a self-closing tap be used, does not appear to be judicious.

4. On and after the first of January, 1879, all Stop Cocks to be fixed on service pipes must be of *larger diameter than such pipes:*—for instance, $\frac{3}{8}$ inch pipes must have $\frac{1}{2}$ inch Stop Cocks; $\frac{1}{2}$ inch pipes, $\frac{3}{4}$ inch Stop Cocks; $\frac{3}{4}$ inch pipes, 1 inch Stop Cocks; and 1 inch pipes, $1\frac{1}{4}$ inch Stop Cocks.

13. No Tap for domestic purposes in Dwelling-Houses, or for drinking purposes in Warehouses, will be allowed to be supplied from a Cistern, but in all such cases Drawing-Off Taps must be fixed on the Service Pipe before it enters the Cistern; Baths, Water Closets, Urinals, and Wash Basins only are allowed to be supplied from a Cistern.

15. Urinals may either be supplied by a Self-closing Tap, of approved description, from the Service Pipe before it reaches the Cistern, or by a Urinal Cistern of approved pattern.

27. The Waterworks' Committee will provide and fix all Water Meters, and will also lay the Service Pipes from the boundary of the premises to the inlet of the Meters and fix the Stop Cocks thereon, at the expense of the occupier of the premises, and such inlet Pipe and Stop Tap must not be interfered with by Authorized Plumbers or any other persons, without the sanction of Superintendent or other authorized Officer of the Waterworks' Committee.

30. Information from Authorized Plumbers, or other parties, as to any infringements of the preceding instructions will receive the immediate attention of the Committee.

31. Authorized Plumbers will be struck off the Lists if found lending their names to unauthorized persons.

34. All Taps (with the exception of those specially allowed as per Regulations Nos. 9 and 15) must be on the screw-down principle, with loose valves

and stuffing boxes; the diameter of all orifices in the seats on which the valves work in the *Taps* to be the same size as the Taps themselves; and all Taps must be capable of resisting a pressure of 300 lbs. to the square inch, to which they will be subjected in testing.

35. The Bib and Stop Taps must be of the following average weights, viz.:—

1 inch	$32\frac{1}{4}$ ounces.
$\frac{3}{4}$ „	21 „
$\frac{1}{2}$ „	$11\frac{1}{2}$ „
$\frac{3}{8}$ „	$8\frac{1}{2}$ „

Double Valve Bib Taps—

$\frac{3}{4}$ inch	$22\frac{3}{4}$ ounces.
$\frac{1}{2}$ „	$13\frac{1}{4}$ „
$\frac{3}{8}$ „	$10\frac{1}{4}$ „

36. Ball Taps must be of the best quality, and the diameter of the Tap and Ball as under:—

1 inch	diameter of Tap,	not less than	6 inches	diameter of Ball.
$\frac{3}{4}$	„	„	$5\frac{1}{2}$	„
$\frac{1}{2}$	„	„	$4\frac{1}{2}$	„
$\frac{3}{8}$	„	„	$4\frac{1}{2}$	„

37. The Rods or Spindles from the Balls to the Taps must not be less than the following lengths:—

1 inch diameter of Tap	13 inches long.
$\frac{3}{4}$ „	13 „
$\frac{1}{2}$ „	11 „
$\frac{3}{8}$ „	11 „

38. The Strength of such Rods must not be less than as follows:—

End next the Tap.	*End next the Ball.*
1 inch $\frac{14}{32}$ by $\frac{8}{32}$ inch	$\frac{10}{32}$ by $\frac{7}{32}$ inch.
$\frac{3}{4}$ „ $\frac{13}{32}$ by $\frac{7}{32}$ „	ditto.
$\frac{1}{2}$ „ $\frac{12}{32}$ by $\frac{6}{32}$ „	$\frac{10}{32}$ by $\frac{4}{32}$ inch.
$\frac{3}{8}$ „ $\frac{11}{32}$ by $\frac{5}{32}$ „	ditto.

The Rods or Spindles referred to above may be of the following strength, in lieu of those stated, viz., $\frac{4}{10}$ by $\frac{2}{10}$ inch.

39. Such Taps without Balls or Spindles must not be less than the following weights:—

1 inch	$22\frac{1}{2}$ ounces.
$\frac{3}{4}$ „	$10\frac{3}{4}$ „
$\frac{1}{2}$ „	$7\frac{3}{4}$ „

Ferrule Taps for Baths.

40. The weight required in future by the Waterworks' Committee for the above Taps *without the handle* will be 20 ounces, and no Taps of this nature will be passed and Stamped of lighter weight.

Specification for Double Valve Cisterns, and various parts thereof.

(Referred to in Regulation 17.)

1. The 73 x and 73 N T Cisterns to give two gallons of water each flush, and to be so constructed as to contain two gallons two inches below the overflow or tell-tale pipe.

2. The Valves to be of lead with brass lining, and brass faces for the Indiarubber Washer.

3. The Valves in 73 x and Small Valves in 73 N T Cisterns to weigh not less than 2 lbs. each, and the Large Valves in 73 N T to weigh not less than $3\frac{1}{4}$ lbs. each.

4. The Valve Rods to be of Brass, and not less than $\frac{7}{32}$ in. in thickness,

and to have a strong brass nut screwed and riveted on to the bottom, a loose brass washer to be placed above the nut in order to take the wear which arises through the Valve being suddenly and repeatedly lifted.

5. The Indiarubber Washer to be of the best quality, and not less than $\frac{1}{8}$ in. thick.

6. The Valve Seats inside Cisterns to be of brass, and fastened down by a strong lock nut and union. The bearing on the bottom of the Cistern to be not less than $\frac{1}{2}$ in.

7. The bearing of the Valve Rods to be of brass, and the female bearing of Cistern Levers to be bushed with brass $\frac{1}{4}$ in. in thickness.

8. The Cisterns to measure 18 in. in length, inside measure, so as to allow the rod of the Ball Tap to be of the proper length.

9. The Indiarubber Buffers to be fixed on the top of the Cisterns instead of being at the underside of the lever.

10. The Trapping Box of 73 N T Cisterns to be supplied through $2\frac{1}{2}$ in. orifice with a proper Valve not less than 3 in. in diameter.

11. The fall or outlet pipe of both 73 X and 73 N T Cisterns to be not less than $1\frac{1}{2}$ in. internal diameter. The pipe in trapping box to be of brass, and to be directly under the outlet valve.

12. The 73 N T Cisterns, Valves and Lever inclusive, to weigh not less than 85 lbs. each, without cover.

13. The 73 X Cisterns, Valves and Lever inclusive, to weigh not less than 65 lbs. each, without cover.

14. Cisterns will only be approved that are constructed in accordance with the foregoing specification.

15. A sample Cistern in accordance with this specification may be seen at the Waterworks' Testing and Stamping Office, Town Hall, Manchester.

Specification for Syphon Cisterns for Water Closets.

1. The Cisterns are not to discharge more than two gallons of water at one flush, whether the pull be quick or slow.

2. The discharge pipe, or under side of the syphon bend pipe, must not be less than $\frac{1}{2}$ inch above the side of the Cistern, so that in case of leakage from the Ball Tap, while the Cistern is not in action, the water shall overflow the side of the Cistern and not go down the discharge pipe, but this must not in any way interfere with the existing Regulatlons as to overflow pipes. There must be no connection with the Cistern and discharge pipe other than the syphon, which must be capable of being brought into action when the water level is at least one inch below the overflow pipe.

3. All working parts liable to corrosion must be made of, or faced with, Gun Metal, or other approved material *not liable to corrode*, and should the syphon or part of it be of Iron it must be of such weight and dimensions as shall in no way lessen the effective working of the Cistern in case of corrosion taking place.

4. No Cistern with piston or other action requiring a quick or sudden pull to start the syphon will be allowed, nor any Cistern that is not capable of being brought into action with a gentle pull or drop of the lever.

5. No Cistern will be approved where there is any decrease in the force of the flush during the discharge of the quantity of water allowed, or which by manipulation of the pull or lever or any contrivance allows a constant flow of water to the closet.

6. All appliances for the discharge of water must be of the simplest kind and not liable easily to get out of order, and be such as can be readily repaired; they must also work with little noise or jar.

7. Iron Syphon Cisterns must have round corners, inside and outside, as a protection against frost.

8. Such Cisterns must be made of the following strength, viz.:—to gauge $\frac{1}{4}$ inch at the top tapering to $\frac{3}{16}$ inch at the bottom.

9. All Cisterns must be 18 inches in length.

Mr. Rogers Field (London) drew attention to the two-gallon system of flushing water-closets. He admitted that it was quite possible for two gallons of water to be sufficient for this purpose, but though the cisterns were of the two-gallon measure they very seldom got the full two gallons of water from them. The sanitary object desired to be gained was this, not merely that there should be sufficient water to flush out what there was in the closet, but that there should be sufficient to carry it away from the house. Possibly, as he had said, they could manage with two gallons for this purpose, but generally they wanted more; but with a hard and fast rule like this, confining the cistern to the two gallons, what were they to do? To be sure they had no desire to waste water, but did the two-gallon cistern prevent a waste? He held that it did not, for a careful person finding the first flush insufficient would wait until the cistern was re-filled, and then flush again. So that really they were not saving water by this system. In Scotland it was the rule for cisterns to hold four gallons, and it seemed to him very necessary that it should be urged on authorities to provide a larger quantity of water, for the point was a very vital one. There were certain closets for which a small quantity was perfectly inadequate. He did not know what regulation prevailed in Brighton in this respect, but if the Corporation confined their cisterns to two gallons he earnestly urged them to alter the system. Another thing he held was that water pipes should on no account be allowed to pass through drains. Nothing was more dangerous. Then with regard to the opinion that had been expressed about pan closets. He quite agreed with it, and he thought if the authorities of Brighton and Hove resolutely set their faces against their use they would very soon get rid of them.

The President of the section asked Mr. Field if, as a sanitarian of great experience, he quite agreed with the legislation that only allowed lead pipes to be used in connection with the water supply in houses?

To which Mr. Field replied that he did not, as water in some cases very seriously affects lead. It was much better in such cases to use iron.

Mr. Wm. White (London) also considered it very injudicious to enforce the use of lead pipes in all cases, and more especially in those cases where there was not a constant flow of water through the pipes. He had known two miles of lead pipe kept perfectly free for many years with soft water flowing through them, but then the pipe was not stopped up at its ends at all. Its purpose was to keep the cisterns in a small village filled with water, and he was asked his opinion about it at the time—nearly twenty years ago—and he believed the pipe was still in perfect use. He was glad that Mr. Field had called attention to the sanitary defect—chiefly emanating from water companies—which limited the flushing of a closet to two gallons. He thought that a full two and a half gallons should be the minimum quantity, and he rather thought that not less than three gallons

should be allowed with option to the management of the cistern. Many people had a great difficulty in keeping their cisterns clean. If the cistern had not a cover it was very liable to collect dust.

Mr. Wray (Brighton) explained that the regulation in Brighton was that their water supply should be such as was satisfactory to their Borough Surveyor. Their cisterns held never less than two gallons, and as a matter of fact three or four-gallon cisterns were often adopted. With reference to pan closets they did not allow them to be put into new buildings, and when it was brought to the notice of the Sanitary Committee that any of those in use were in a bad state they had them taken out. It would be understood, he thought, that in some cases they had to use powers of persuasion in the attainment of this end in preference to going about the matter peremptorily. He thought if The Sanitary Institute were to come to Brighton again in a few years' time they would be able to see that all their sanitary details and principles were as near perfection as possible.

Mr. Baldwin Latham (London) agreed with Mr. Field about the desirability of having larger cisterns, and he explained that the two-gallon system was due to an Act of Parliament framed with reference to the metropolis. The Board of Trade had had the power to make the regulation, which, he stated, had been arrived at after considerable investigation and enquiry in very many towns. It was quite clear to him that, having regard to the great length of main drains, it was very desirable indeed that the quantity of water should be sufficient completely to carry away all matters which accumulated. With regard to leaden pipes, they were in some cases very injurious, and especially had they proved so in Yorkshire, where they had had a great deal of trouble from the poisonous character of certain of the waters. It was somewhat curious that this poisonous character was not always the same. For some years they would have lead poisoning taking place, whilst in other periods it would not occur at all. When the Board of Health started they had an idea that everything should be in iron. Croydon was one of the towns which had its water service entirely in iron, and the result was that when the pipes were laid under the ground level they would in a very short time—a fortnight in some cases—be eaten through so as to leak. At the time it gave them great trouble and anxiety to know if they could substitute lead for iron. At last all the iron pipes were taken up and lead ones put in their place. This evil of subterranean leakage was most dangerous. In one case where the pipes went under a slaughter house there was a leakage and the whole of the neighbourhood could draw nothing from their taps but blood and water, the soakage and washage from the slaughter house having been drawn into the pipe and polluted the whole of the water supply. When lead was used, only those towns like Brighton and Croydon which had a chalk water supply, were entirely free from the danger of lead poisoning. Indeed, he was of

opinion that chalk supplies would probably be found the ultimate remedy for the injurious effects of both iron and lead. The water of the Bagshot sand was equally liable to affect lead, and in that case of course some other means would have to be taken and other materials substituted. Above ground there could be no objection to using iron in many cases, nor was it now insisted that all joints in pipes should be plumbers' joints. In fact it was much cheaper and equally if not more advantageous to use cone joints. It was essential that some regulation should be adopted to prevent contamination with sewage and foul matters, and one step in attaining that end would be gained by abandoning intermittent supplies.

On "Brighton as a Health Resort." A short review of the various Works executed from the year 1858 *to the year* 1890, *by the Engineer and Surveyor's Department of the Corporation of Brighton acting by the Council as the Urban Sanitary Authority for the Borough. By* FRANCIS J. C. MAY, Assoc.M.Inst.C.E., Borough Engineer and Surveyor.

BRIGHTON, a "Health Resort," is the title of this paper, and my object is to show, from an Engineer's point of view, how the town is by nature pre-eminently qualified to hold that title; this position has been duly recognised by successive generations of the inhabitants, of which each has done its best, according to the knowledge of its respective age, to promote the health, comfort and pleasure of its visitors, and at the same time to further the best interests of the town; but it is my intention to refer more particularly to the improvements achieved during the last thirty years, that being the period which has been devoted more especially to the study and practice of the laws of sanitation in relation to the person, the dwelling, and the town. During this period the Corporation of Brighton has continually persevered with indomitable courage to keep well to the front in all sanitary and useful measures, spending liberally yet wisely, sparing no expense to preserve and improve the natural beauties and advantages of the place, and making a profitable use of the rapid strides in the knowledge of sanitary science generally. From the year 1858 to the end of the year 1889 my respected predecessor, Mr. Philip

C. Lockwood, M.Inst.C.E., was Engineer and Surveyor. He most ably and wisely advised and assisted the Corporation in all their deliberations, and afterwards devised and carried out their great works in the most scientific and faithful manner. This unbroken length of service of the Engineer and Surveyor, in my opinion, contributed in no small degree to secure the general success of the various improvement schemes that have from time to time been promoted—one master mind having arranged the whole work, whereby the proverbial spoiling of the broth by the meddling of too many cooks has been avoided. With this short introduction, I now proceed to the matter of the paper.

The situation of Brighton is in 50° 55′ N. latitude, and about 3′ W. longitude on the eastern side of a shallow bay of the south coast; the centre of the town is in a valley, sheltered from the piercing north and east winds by the Sussex Downs, and facing nearly due west, which renders it a most desirable residence during the inclement weather so prevalent in our climate from September to the end of April, or even later. For this reason it is indeed a "health" resort to all those persons whose constitutions suffer from the severity of winter weather, and who can afford to choose their own residences, or have the opportunity of occasionally enjoying a change of air.

The soil is also very favourable from the "health" point of view. That to the east, north, and north-west is principally a thick sub-stratum of chalk, covered with a thin layer of earth. The subsoil of the centre is marl and shingle, while to the westward there are large beds of clay of a very irregular character. The surface of the land is very undulating, and the town therefore presents a succession of hills and valleys in every direction, as may be understood by studying the levels marked on the contour map. This gives rise to the opinion often expressed, that Brighton in respect to temperature, and the sensation of cold, offers a great variety of climate according as the situations are more or less elevated, sheltered, or exposed. I would here remark that, when the wind is in the north or east, the Madeira Road under the East Cliff offers to the invalid a climate suggestive of the air of the island from whence its name is derived.

While the sea, with its fishing, boating, and bathing facilities, is one of the great attractions of Brighton, it has also been its greatest foe. Lying in such a situation as to be open to the fury of the violent south-west and westerly gales, Brighton has from time immemorial suffered seriously from the encroachments of the sea. Although these inroads have been very extensive, it appears that the skill of the engineer to combat

with them was not enlisted till after the storm in the year 1713, when the first timber groynes were built westward from the Old Steine. Those eastward as far as Black Rock are of more modern construction, commencing about the year 1819, the sea at that date making rapid inroads upon the whole of the cliffs of the Marine Parade. The money required for these sea defences was raised by means of a coal duty of 2s. 6d. per ton on all coals brought into the town, under the Brighton Town Act of 1810, but these dues ceased on September 13th, 1887. After the construction of these groynes, the building of a sea wall was easily accomplished. The first portion formed was that between West Street and Middle Street, and was opened by King George IV. in the year 1821. The fine old sea wall along the Marine Parade, which is built of lime concrete (at that date quite a novelty), the work of Mr. W. Lambert, was completed in the year 1835, at a cost of upwards of £100,000. The wall, one mile and one quarter in length, is in many places sixty feet high, twenty-three feet thick at its base, and batters on an average four inches to the foot on the face. After this great work was completed, no other work of importance was undertaken till after the year 1858 (the period of which I am going to write more in detail). The government of the town, nearly up to this period, was by a body of Commissioners, of whom the High Constable was chief; but in the year 1854 the town was incorporated, and after this date a greater degree of energy and prosperity set in. In the year 1858 Mr. Lockwood was appointed Borough Surveyor. On his retirement, in the year 1889, he was appointed Consulting Engineer to the Corporation, and in that capacity has superintended the more recent addition on the Madeira Road.

The system of groyning, adopted by Mr. Lockwood since the year 1858, has resulted in the reclamation of twenty-three acres of land from the sea, which has enabled the Corporation to increase the width of the carriage-ways and esplanades on the front to their present noble proportions, besides securing the splendid stretch of beach now to be seen.

The Esplanade on the King's Road has been widened three times. The Corporation has thus secured to the town a noble sea-front, nearly three miles in length, with a carriage-way on the top of the cliff of an average width of 53 feet, with an Esplanade and Parade about 40 feet wide; while under the cliff there is an Esplanade from the Western boundary to the Albion Groyne, opposite the Aquarium, about 20 feet in width, and eastwards therefrom a carriage-way, with a foot-path known as the Madeira Road, from the Aquarium to a point opposite Sussex Square, near which place a junction is formed with the

upper road by means of an inclined road, of a total width of 60 feet.

The widening of the sea-front has been effected by forming arches to carry the roadways, and these arches form pleasant retreats or lounges, having a good view of the sea, and are much enjoyed and sought after by both residents and visitors. This is a very novel feature, and well worth a visit; some of the arches are fitted up in a most luxurious style.

In the month of May this year a further improvement was effected in the Madeira Road. It comprises a commodious Shelter Hall, embracing every convenience one can reasonably desire, with a covered walk 1250 feet in length, of which the roof forms a terrace promenade, which may be approached by the elegant lift, which enables persons or invalids in bath chairs to ascend or descend from the Marine Parade on the cliff to the Madeira Road below, without the fatigue formerly experienced by climbing the long flight of steps. This improvement cost the Corporation upwards of £15,000.

The whole of the splendid sea-front promenade from East to West is brilliantly lighted at night by 180 Suggs' lamps, burning 30 cubic feet of gas per hour each.

From the year 1860 upwards of £2,000 also has been spent in providing seats for the comfort of the people on the front. Shelter from the weather, rest for the weary and the invalid, has been provided in abundance, together with every convenience and sanitary arrangement to promote their cleanliness, health, and comfort while taking exercise and enjoying the sea breezes to recuperate their strength of mind and body. With a view to prevent pollution of the air, special attention is given to the cleansing of the carriage ways and cab-stands on the sea-front and in the principal streets. In addition to the ordinary methods of scavenging, a system of street orderlies has been adopted, by which means the horse droppings, and everything of a like objectionable character, is removed from the surface of the roadway as quickly as possible. The cab-stands (about three miles in length) are all formed of cement concrete, and are kept in a cleanly condition by frequent and copious washings. The pavements are frequently and regularly swept, and the sea-beach is kept in good condition by the daily removal of all sea-weed, decaying matter, and refuse of all kinds likely to be detrimental to health, or offensive to sight or smell. Nearly £4,000 has been spent in the formation of paved cab-stands on the front during the same period.

This long list of improvements on the front, exclusive of groynes or sea-walls, has cost the total sum of nearly £75,000 (as per table at end); but there has also been an infinite

number of minor improvements within the Borough which it is impossible to mention within the scope of this paper, and of which the total would represent a still further large sum. I have therefore confined my remarks to the improvements on the sea-front. These grand works are protected from further inroads of the sea by six concrete groynes and fifteen timber groynes, constructed between the years 1862 and 1888, at a total cost of over £75,000, of which the details will be found among the tables at the end of this paper.

The street improvements are far too numerous and varied to be named separately, but some idea of their magnitude may be realized from the fact that upwards of £30,000 has been spent between the years 1860 and 1890 in the most prominent places alone.

The Corporation of Brighton has been fully alive to the importance of the fulfilment of its duty to provide open spaces as the lungs of the Borough. The parochial graveyards have been levelled, laid out with walks, planted with trees, and provided with seats, by which means they have become useful open spaces, and are greatly appreciated. "The Level," an open space of more than 10 acres, lying between the London and Lewes Roads, quite in the centre of the town, was in the year 1877 taken in hand, and by the judicious outlay of about £2,000 rendered a most delightful public recreation ground. In the year 1879, the Corporation received from the Executors of the late W. E. Davies, Esq.—all honour to his memory!—the munificent bequest of the princely sum of £70,000, to be applied by them at their discretion for the benefit of the town, and with this money "Preston Park" was purchased in 1882, at a cost of £50,000. It contains about 60 acres of land, and has since been laid out for the use and pleasure of all grades of the public in the most attractive manner, at a further cost of about £15,000. There are to be found cricket grounds, tennis lawns, cycle tracks, "Rotten Row" for equestrians, walks and drives, chalets, and every public and sanitary convenience for the comfort and health of all ages and sections of society. By the munificent gift of the Race Stand Trustees (Messrs. Alderman Abbey, Brigden and Ridley, and Seymour Burrows, Esq.) the Fee Simple of "The Race Hill," or "Tenantry Down," containing about 105 acres of land, was acquired for the public use (previously to this the public had only the right of walking over the land) on the easternmost boundary of the Borough, and forms the most delightful and healthful resort that can be imagined, being an interesting portion of the noted South Downs. Here are to be found most magnificent and extensive views over land and water, with

health-giving balmy air of the Downs, or ozone from the sea—altogether a most lovely, quiet retreat. Quite recently "The Queen's Park," which is situated in the centre of the thickly populated eastern wing of the town, has also been presented to the town by the Race Stand Trustees. It contains about 21 acres, and was purchased by the Trustees at a cost of £13,500. Plans have been prepared for its disposal as a public recreation ground and botanical garden, of which the cost is estimated at £4,000. When completed, this, from the undulating and otherwise suitable character of the land, will be the prettiest of all the public recreation grounds of the Borough. Too much praise cannot be given to the Race Stand Trustees for their untiring efforts to secure these two magnificent gifts for the benefit of the public of this important Borough.

Sanitary Measures.

The Borough Sanatorium and Disinfecting Station, which may be considered as a temporary building (to be superseded soon by one on a larger scale, and of a permanent character), was erected in the year 1881, and with additions since has cost about £10,000. In the Spring of the present year the first section of the permanent work was completed at a further cost of £1,811. It consists of a well-appointed steam laundry, designed in all its parts on the most modern principles, and is as perfect and convenient as modern science has yet devised. The Sanitorium is situated on an eminence of over 300 feet above Ordnance Datum on the North-eastern corner of the Borough boundary. Although the buildings are of a temporary character from the fact that they had to be erected in great haste owing to fears entertained at that date of an epidemic (which fortunately did not occur), yet they are thoroughly well-appointed in their internal arrangements. There is also an efficient staff, and under the able supervision of the energetic Medical Officer of Health (Dr. Newsholme), it is one of the most useful Institutions in the Borough.

The drainage system of the Borough may justly be considered one of the most important sections of the sanitary work of the Engineer and Surveyor's Department. In the year 1860 there were 11 miles of sewers in the streets. There are at the present date 72¼ miles. The importance of this question to such a town as Brighton was from the first thoroughly recognised, and the following eminent engineers were consulted on the subject:—Sir Robert Rawlinson, Sir John Hawkshaw, Sir Joseph Bazalgette, Mr. Hawksley, and Messrs. Bright and McLean, in conjunction with Mr. Lockwood. The result of the combined wisdom and experience of these illustrious men

has been the adoption of what we claim may be considered as one of the best systems of main sewers. Such old sewers as were found defective were abolished and replaced by new; those which were sound were ventilated and otherwise adapted to the new system. The cost of the main sewers was about £120,000. Great care was taken in the construction of the new sewers to ensure the use of the best materials of their several kinds, and the laying of the pipes with sound joints and true gradients to render them as nearly self-cleansing as possible. This was no slight task, owing to the steep gradients of many of the streets, in some of which it was found necessary to lay the sewers in a series of steps. The sewers have been so arranged in districts or sections for ventilation, as to cut off those of the lower from the higher level.

The system as first constructed had three outfalls into the sea, one at each boundary of the Borough—east and west—and one about midway between the boundaries and opposite the Albion Hotel; but in the year 1869, Sir John Hawkshaw designed the great Intercepting Sewer, which is laid along the whole front from the Western boundary of Hove to the outfall at Portobello, a length of 7¼ miles, and 3·87 miles distant from the Eastern boundary of Brighton. This Intercepting Sewer is formed in three sections; it is built of brickwork in cement as follows:—

9,918 feet of	5 feet sewer.	
700 ,,	6 ,,	,,
27,826 ,,	7 ,,	,,

The fall is 1 in 1760, or 3 feet to the mile.

The cost of the Intercepting Sewer was £104,608; it was commenced in 1871 and finished in 1874. The main sewers were originally ventilated only by the usual form of air grates in the centre of the streets, but owing to the steep gradients of many parts, this system was found very imperfect, so that as far as practicable they have been closed, and a system of large open shafts has been instituted, formed of concrete tubes two feet in diameter, built into brickwork carried up in every available situation. This plan has been adopted very extensively, and every opportunity that offers of adding to the number of shafts is carefully sought and utilized. The intercepting Sewer is almost entirely closed, but is most efficiently ventilated by means of the furnace constructed at Roedean, about one and a quarter miles from the Eastern boundary of Brighton. This furnace is kept burning continually, and is quite a unique and interesting feature of the sewerage system of Brighton. The cost of construction was £1,341 9s. 8d., and the cost of maintenance is £120 per annum. The members of The Sanitary

Institute will be invited to visit the furnace, and Mr. Lockwood will be prepared on the spot to give a more detailed description of its working, and other particulars connected with the Intercepting sewers than can be embraced within the limits of this paper.

As the Intercepting Sewer receives the whole of the sewage of the sister town of Hove, the expense of its construction and maintenance is shared between the towns of Hove and Brighton in properly adjusted proportions, under the management of a Joint Sewers Board, composed of ten members of the Hove Commissioners and twenty-eight members of the Town Council of Brighton. The average cost of maintenance is about £1400 per annum. A short time ago it was determined to extend the outfall at Portobello. Formerly the sewage was conducted seawards from the Intercepting Sewer by three 4 feet diameter wrought iron tubes, a length of 300 feet from the face of the cliff, but they have recently been extended a further distance of 730 feet, or 1030 feet from the face of the cliff. The contract price of this recent extension was £9,900. Thus the Corporation of Brighton is relieved from all anxiety or trouble on that much vexed question, "the disposal of town sewage," but the position has only been obtained by a bold and masterly grappling with the question—a spirit which seems to have been their guiding star in all their undertakings. The public sewerage system having been designed and laid down on the most scientific principles, and in all respects in such a way as to secure its thorough efficiency, this having been accomplished, the Corporation then turned its attention to another equally and perhaps in some respects more important part of the subject, viz., the inspection of the condition of the existing house connections, and those to be connected then and thereafter. For this purpose a Drainage Inspector was appointed under the direction of the Borough Engineer and Surveyor, with a competent staff, whose duty it is to inspect and correct all the details of house drainage, traps, ventilation, &c.; to see every pipe before it is covered, and when completed to test each drain, or branch of a drain, by the test known as the "water test." There is also an efficient staff of Sanitary Inspectors, under the control of the Medical Officer of Health. The system of house drainage, trapping, ventilation, &c., is shewn by the drawings which are exhibited, and by the model placed in the Health Exhibition held in connection with this Congress. It may briefly be explained as being designed so as effectually to cut off the house from the public sewer, to secure thorough self-cleansing water-tight drains, and perfect æration of the drains by inducing constant currents of fresh air through them. Thus

the air of the house is kept pure, and pollution of the soil under the house is quite prevented.

The cleanliness of the main sewers and their thorough efficiency is effectually secured by the regular system of flushing, which is carried on by means of plugging the sewers at the manholes, which are then filled with water to the extent of from 200 to 1500 gallons at each flush. This method is also shewn by diagrams on the walls, and a model in the Exhibition. A number of men are constantly engaged in this system of inspection and flushing, and the cost to the Corporation is not less than £500 per annum. The amount of water used per annum is from 18 to 20 million gallons, in addition to that used for household purposes, and the rainfall, which is not excluded from the sewers.

A most complete, but easily understood record of every drain inspected and tested, and of every public sewer flushed and repaired, is made daily. It is properly tabulated in a complete register, so that the information as to the condition of any house or sewer is readily available at all times for all purposes. A great deal more may be written on the value of all these sanitary arrangements, but I leave that to Dr. Ewart, a former Chairman of the Sanitary Committee, who has already treated of it most ably in a paper read upon the subject, from the medical practitioner's point of view.

The water supply of Brighton is now entirely in the hands of the Corporation, having been purchased in the year 1872 at a cost of £352,000. There have been important additions made to the scheme since that date, which have cost several thousands of pounds. I only allude to this undertaking in passing, as it is dealt with in a separate paper by Mr. Alderman Hallett, than whom no one is better qualified to give an account of it.

Another point in sanitation to which the Corporation has given great attention is the prompt and regular removal of house refuse. This is most efficiently done once a week by dividing the Borough into six divisions, and the employment of a regular staff of men and horses under the supervision of Inspectors. Special arrangements are made in the case of large establishments. The ashes are taken on to agricultural land outside the inhabited area of the Borough, and delivered free to the farmers, in addition to the payment to them of a small sum by way of rent for the use of their land as a tip; or they are taken to the ash yard at Hollingdean Road, on the Northern outskirts of the Borough, where they are sifted, and find a ready sale to brickmakers or farmers, being conveyed to any distance on the London, Brighton, and South Coast Railway, from the railway siding laid into the ash yard. The

system of collection and its supervision is very perfect, so that by a prompt and regular removal of house refuse, the air in the neighbourhood of dwellings is kept pure.

The butchers' "slaughter-houses" are licensed and put under strict supervision, so that the pollution of the air from this source is prevented.

The scavenging of the streets is also most carefully attended to.

In common with all old towns, Brighton has some places within its area occupied by the poorest class of its population, which, from the lapse of time and other circumstances, have become unsuitable or undesirable dwelling places. The Corporation has already taken in hand two of these large areas under the Artizans and Labourers Dwellings Act, so that an immense number of these old dwellings are to be demolished, and other suitable houses are to be erected for the use of those persons displaced by the improvement.

Having regard to the advantages of electricity over gas, from a sanitary point of view, in maintaining the greatest degree of purity of the atmospere within our dwellings, houses and shops, the Corporation has recently decided to erect an Electric Lighting Installation, with a view to supply the light at a price not in excess, by comparison, of that charged for gas. Power can also be supplied by the same system. The scheme has been prepared by James N. Shoolbred, Esq., C.E., and the cost estimated at £30,000. The usual Local Government Board enquiry has been held, and sanction given to the loan. Tenders for each section of the work have been obtained, and the total cost is within the estimate, so that it is expected that the work will be forthwith commenced, and the light will be soon extended to other portions of the town.

The Corporation has duly recognised the truth of the old adage, "Cleanliness is next to godliness," and its effect upon the health of the community. We have the sea as a bathing place for those who can afford time for the luxury; there are bathing institutions in the town for all who can afford the comfort of their appointment; but the Corporation has instituted establishments known as "Public Baths" for males and females, situate in the neighbourhoods where they are most convenient for the working classes, who have the privilege of obtaining a bath at the moderate charges of: First class—Hot, 6d.; cold, 3d. Second class—Hot, 2d.; cold, 1d.

The North Road Baths were opened in 1871, at a cost of £1,834; enlarged in 1874, at a cost of £4,034 with further additions in 1885, at a cost of £575. The Park Street Baths were opened in 1888, at a cost of £5,544. That these baths have been thoroughly appreciated by the people, and are a use-

ful factor in promoting the public health, may be fully realized by a reference to the following table of the number of bathers:—

1885 ...	68,169	1887 ...	76,236	1889 ...	98,824
1886 ...	72,790	1888 ...	92,426		

The formation of a suitable swimming bath at Park Street Baths, is under consideration at the present time.

With a view to render baths more attractive and useful, the Corporation have decided to try the experiment of a system of cottage baths dotted about in the poorest and more densely populated districts; this will have the effect of avoiding long walks to a central large bathing establishment. It will, indeed, be taking the baths to the people, and it is hoped will be a popular movement. The first institution of this kind is being constructed at the present time at Brunswick Place, North. Here a large house has been hired by the Corporation for a term of years, and is being fitted up with eight baths, four for men and four for women, supplied with both hot and cold water. The establishment will be under the care of a man and his wife, who will reside on the premises. From the interest already taken in the progress of the operations by the class of persons for whose use it is intended, there is every reason to believe the experiment will prove a success.

The Royal Pavilion, built by H.R.H. the Prince of Wales, afterwards King George IV., in 1784-7 as a royal residence, was purchased by the Corporation of Brighton in the year 1850 for about the sum of £60,000. In the years 1866-7-8 considerable improvements were made in the buildings at a cost of £7,310. The buildings and grounds are devoted to the public use. The rooms are being continually requisitioned for balls, concerts, and meetings of religious, scientific, benevolent, political, and other societies. The grounds are tastefully laid out, and form a most attractive and agreeable promenade and health-giving resort. The Dome is furnished with a splendid organ, and is often used for concerts and large public meetings. In 1871 a Free Reading Room and Reference Library, Museum and Picture Gallery, were established in the grounds adjoining the Dome at a cost of £7,402, and are a great acquisition for the health of the public mind. The buildings are lighted at night by an Electric Lighting Installation, erected by the Corporation on the estate in the year 1883 at a considerable cost, as the electric light was then in its infancy, and improvements have been made from time to time as a knowledge of the science has progressed. £5,046 stands as the capital sum expended up to the present date. In the year 1889 a magnificent Free Public Lending Library was opened and established

on the Pavilion estate, at a cost of £2,350 for books and fittings, in commemoration of the jubilee of the reign of Her Most Gracious Majesty Queen Victoria. The extent to which this is appreciated by the public will be understood by a perusal of the return of borrowers of books during the month of June, viz., 8645, and this shows a rapidly growing increase. The Corporation are now entering into arrangements for an additional building, to increase the accommodation so urgently required in this department.

Having given a brief description of the work already done, it will not be out of place, nor betray any official secrets, if I state that it is not the intention of the Corporation to remain satisfied with what has already been done; but, on the contrary, that there is a strong determination to progress in every direction, and to keep pace with the march of science in the interests of the public health. A public abattoir; a refuse destructor; a grand extension of the sea defences eastwards in the parish of Rottingdean, with suitable drives and promenade; a scheme for the better utilization of the Tenantry Downs; a yacht station opposite Kemp Town; various street improvements to relieve the congestion of some of the more crowded thoroughfares; and a new Town Hall, are matters which are already engaging the attention of the Corporation. Indeed the summing up of the whole matter cannot better be accomplished than by repeating the words which fell from the lips of the present Mayor of Brighton, on a public occasion, a few months ago:—"the very best of everything is not too good for Brighton," a sentiment which produced an audible and unanimous echo from the lungs of the large concourse then present. This shews how thoroughly and cordially the people trust, appreciate, and support the efforts of the "powers that be" for the common benefit of all classes of the community. Where this spirit and this principle predominates, the greatest and best achievements for good may be expected and accomplished. I hope, however, that I have submitted sufficient evidence to prove the assertion made at the commencement of this paper, viz., that the town of Brighton is by nature pre-eminently qualified to be called a health resort; that this has been fully recognised by successive generations of the inhabitants for the last 150 years; and that especially during the past 30 years the Corporation of Brighton has been most untiring in its exertions and wisely lavish in its expenditure, to secure to the borough the fame of being "the Queen of Watering Places." I venture now to go even further, and to prognosticate that from the public spirit which still pervades all classes of the community, and the grand schemes that have already been mooted for the further improvement of the

town, the time will shortly come when Brighton will be known far and wide by the imperial title of "Empress of Health Resorts," in addition to her present regal title of "Queen of Watering Places."

In concluding this paper, I acknowledge with gratitude the willing and generous help accorded me by each of the official heads of the various sections of the department of which I now have the honour to be chief, and other friends. As I have only held my appointment about eight months, it would have been impossible for me to have submitted to you the facts recorded in this paper without their assistance. My predecessor, Mr. Lockwood, will kindly take my place in the discussion that may ensue, and will give any further information that may be required.

Drainage.

Public Sewage Works	£120,000
Intercepting Sewer	104,608
Roedean Furnace Ventilating Shaft	1,341
Ventilating Shaft and Flushing Chamber at Rottingdean	1,126
	£227,075

This does not include the cost of extending the outfall pipes at Portobello, the contract for which was £9,900, as the work is not yet completed.

Population, Length of Highways, Sewers, &c.

Year.	Population.	Highways.	Sewers.	No. of Houses.
		Miles.	Miles.	
1861	77,693	55	11	13,307
1875	99,374	$64\frac{1}{2}$	$53\frac{1}{2}$	15,776 (1871)
1890	123,659	$85\frac{3}{4}$	$72\frac{1}{4}$	18,668 (1881)

Some items of Brighton Expenditure, 1859—90.

	Cost of Works executed by Boro' Engineer.	Improvements on Sea Front.	Groynes.	Preston Park.	Baths.	Water Works (exclusive of laying mains, &c.)	Royal Pavilion Improvement (exclusive of cost of redecorating rooms	Drainage	Sanatorium.
	£	£	£	£	£	£	£	£	£
1859	24,357								
1860	24,619	......	400						
1861	36,411	......	400						
1862	27,573	......	2785						
1863	25,440	......	400						
1864	34,176	4813	4760						
1865	52,926	4813	6591						
1866	62,665	1778	5583	......	......	......	3150		
1867	65,442	1778	400	......	......	......	3150		
1868	63,631	......	4258	......	......	......	1010		
1869	73,696	......	2531						
1870	61,407	......	400						
1871	65,523	1148	400	......	1834	......	7402	Total £227,075	
1872	63,619	1004	2336	......	......	352,000			
1873	42,305	......	1168						
1874	46,437	......	1420	......	4034				
1875	55,836	......	637	......	575				
1876	46,546	......	4080						
1877	57,811	......	12179						
1878	53,334	......	1869						
1879	57,537	......	1108						
1880	58,222	6452	400	......	......	1165			
1881	64,461	1650	809	......	......	......	......	......	4470
1882	73,439	1428	400	55000	......	1706	......	......	3320
1883	76,580	6399	1390	2492	......	319	2705		
1884	92,742	......	3884	2491	......	1024	2906	......	1114
1885	70,047	......	4237	2878					
1886	68,324	......	4098						
1887	78,537	......	400	594	......	......	161		
1888	71,737	25466	6405	1588	5544	......	......	......	994
1889	......	1297	400	......	......	......	115		
1890	......	16415	......	......	276	......	590	......	1811
	*	74,000	76,000	65,000	12,000	356,000	21,000	227,075	11,709

£342,784 Total.

* The Total, 1859—1888, was £1,675,580.

Professor T. Roger Smith (London) first remarked that Mr. May's paper afforded such a comprehensive and interesting statement as to make one admire the untiring energy of the Brighton Corporation in matters both of sanitation and improvement.

Mr. C. H. Cooper (Wimbledon) thought Mr. May should have

directed more of his remarks to the health of Brighton. There was a list published, he did not understand by whom, showing that Brighton's death-rate was the lowest of the towns with which it was compared. Singularly enough, however, that list contained no mention of such acknowledged health resorts as Hastings, Scarborough, Eastbourne, Weymouth, Bournemouth, Torquay, Ramsgate, Ilfracombe, &c., and he thought this omission was somewhat unfair, especially as in many of these places the death-rates were very low indeed.

Mr. Baldwin Latham (London) asked what amount of leakage there was into the outfall sewer? It seemed to him that it was very extraordinary that instead of increasing the number of their outfall sewers the Brighton authorities, finding greater demands upon them, had extended their length, a proceeding which he held must certainly diminish the effect of their discharging capacity. The effect of this lengthening was simply this, that whilst the present sewers were ample for all purposes of conveying away the sewage of Brighton when the rain fell the overflow that took place of sewage and salt water must be enormously increased. He wanted to know therefore how many hours at neap tide the interior of the sewer was absolutely free, and also what steps were taken for cleansing it? With regard to the question raised by Mr. Cooper, he understood that the list of towns with which Brighton's mortality was compared in the manner he had named was framed by the Registrar-General. It was true it did not mention all the large towns, but they were such towns as were large when the returns were first made, and owing to the difficulty of making alterations, other towns entitled to be mentioned on the list had failed to get their request to be placed on it acceded to. So far as Brighton was concerned, the death-rate given in these returns was not reliable, for the town's population had been over-estimated. In reality this rate was slightly higher than that generally believed, a conclusion which he had arrived at by estimating the population after the method which he brought before the Medical Congress a few years ago. This method was to divide the births by the deaths since the last census and add the remainder to the population at that period. When the next census was taken Brighton would find that its population had increased in only a very small degree. With regard to the general character of the works which had been executed in Brighton he was of opinion that they had been exceedingly well done, though with reference to the sanitary arrangements of the town, he had to bear out the remarks of previous speakers that they were not always perfect. For example, he was staying at an hotel where the old pan closets were used. Anything more disgusting than these he could not conceive, nor could he conceive how any person could tolerate such disgraceful sanitary appliances. House drainage too was done in many towns in a manner more simple than in Brighton. He was sure that Brighton people would only thank them for drawing attention to these matters. He hoped when next they wanted sanitary works carried out they would not go, as they had done previously, to a railway engineer.

Mr. May (Brighton), being called upon to reply, said that the remarks which had been made would be borne well in mind after the Institute had left the town. He unfortunately found himself in a very difficult position with reference to the questions which had been asked and had not already been answered, for he had only been surveyor of Brighton a very few months, and the ex-surveyor, Mr. Lockwood, who was to have been present to answer any points which might be raised in the discussion was too unwell to be in attendance. Brighton was so large a town that he had not yet had the time to get all its details at his fingers' ends; and so far as the outfall sewer was concerned that was beyond his province, for Mr. Lockwood, who had commenced the work had been retained by the Sewers Board to see the completion of its extension. Under these circumstances, which he felt sure the section would quite understand and respect, he was unable to answer the question which had been raised, and he could only hope that opportunity would be afforded by a personal visit to the sewer for the members of the Congress to get an explanation of these things of which he had not personally the knowledge to make clear to them. With reference to the condition of Brighton from what he might call a medical officer's point of view, such as its birth-rate and death-rate, he had purposely refrained from entering upon these topics because they had been or were to be dealt with by papers prepared for the Congress by Dr. Newsholme, Dr. Ewart, and Dr. Turton. He did not of course wish his paper to overlap theirs, and he thought that all Mr. Cooper wanted to know would be found in the papers which those gentlemen had taken the trouble to prepare.

On "The Necessity for Improvements in the Sanitary Arrangements of Dairy-Farms, and for their more Careful Inspection by Sanitary Authorities," by Walter Hepworth Collins, F.C.S., F.R.M.S., &c., Member of the Society of Public Analysts; Consulting Chemist and Gas Examiner under the Gas Works Clauses Acts for the Local Board Districts of Pemberton, Kersley, &c.; Analyst and Gas Examiner to the Bolton Corporation Gas Works, the Ashton-under-Lyne Gas Company, &c.

The absolute necessity of a good supply of suitable water to farms, and dairy-farms in particular, is eminently obvious; and as a general rule, farms anywhere near a large town are perfectly safe in this respect. Those farming establishments,

however, situated some considerable distance in the country, have to depend on their water supply from ponds, springs, brooks, and wells; and in these cases the water is used for both domestic and cattle purposes, cleansing, and all ordinary household operations, without as a general rule any attempt or apparent effort at purification. Many of these farms send daily by rail all their milk, butter, and cream to large populous centres; and as such farms are the principal sources of supply of these "necessary comestibles," it is essential that their sanitary conditions and surroundings should be of the most perfect character in the interests of the public in general, and the regular milk consumer in particular.

It has been repeatedly shown that milk is one of the best "carriers" we have of micro-organisms or disease germs of a malignant as well as a beneficent character; consequently it behoves all sanitary authorities and their officials to exercise the utmost care in the inspection and supervision of dairy premises, and in the judicious enforcement of the law relating to and regulating such premises, as well as the retail milk-shops.

It is apparent that much danger can arise from these places—a danger that would undoubtedly influence the death-rate of our large towns; and the typical country farm, with its slovenly constructed premises—although probably most picturesque—and its absolutely unsanitary accessories, is indeed suggestive of a source of unlimited danger to public health. The drainage is, as a rule, unconfined and exposed, and generally gathered together into a small pond in the farm yard, from which the cattle are permitted to drink. The shippons and cow-houses are exceedingly badly drained and worse ventilated, and the air of the shippon simply teems with micro-organisms of a more or less malignant character.

I recently had occasion to inspect and investigate the sanitary condition of an extensive dairy, from which immense quantities of milk are sent daily into one of the largest cities in the kingdom. Dealing with the water first, I found that their only supply was from a spring rising in a field, a considerable distance away, and which field had lately been manured with offal and other slaughter-house matter! The drainage from this field ran direct into the water-course from the spring, and this water was then used without any attempt at filtration, settlement, or any other treatment whatever, for all domestic, dairy, and farm purposes.

An exhaustive microscopical examination of the water showed numerous diatoms, desmids, algæ, and infusoria belonging to the paramecia. A bacteriological examination of the water was then made by the gelatine process referred to by my friend

Dr. Percy F. Frankland, in the Transactions of the Sanitary Institute Congress, 1887, and the sample selected, after being passed through an ordinary domestic carbon filter, yielded 3,600 micro-organisms per cubic centimetre.

A portion of the same sample gave the following results on analysis :—

Total Solids (grains per gall.)	39·36	
Organic Carbon	1·921	per 100,000
Organic Nitrogen	1·036	„
Ammonia	1·104	„
Chlorine	11·569	„

This water had been regularly used for years; but the household had experienced almost periodic attacks of fever of a low description.

The pond water in the farm yard was highly polluted by shippon, stable and house (dairy slops) drainage, and also sewage from the house itself; but the cattle drank, in passing, from this pond with absolute avidity! I was, however, informed that they suffered from regular attacks in summer weather of diarrhœa, the cause of which could not be accounted for.

The air of the shippon, or cow house, was found to yield on examination the following :—

Mean of Twelve observations.

Carbonic Acid	17·3	per 10,000 vols.
Organic matter	69·96	per cent.
Bacteria	209	per cubic centimetre.
Moulds	315	
Total Micro-organisms	524	

The shippon was a long low building with small ventilating holes near the roof, the floor being paved with bricks; the drainage ran along an open gutter in this floor, along the length of the building and out through a small hole in the bottom of the wall, across the farmyard, and into the pond above referred to. Fresh air was admitted through three large holes cut through the door at the bottom, and also by a small flap-door window. The samples of air were all taken during the time the animals were being milked.

The air of the dairy house where the milk was cooled, churned &c., and the cans made up, cleaned, and washed, was examined with the following results :—

Mean of Nine observations.

Organic matter	40·16	per cent.
Bacteria	115	per cubic centimetre.
Moulds	96	
Total Micro-organisms	211	

A dilute solution of "crude carbolic acid," of the strength of one ounce acid to one gallon of water, was used in the dairy for

washing the floors, benches and shelves. A sample of this solution in use was carefully examined, and found to contain 1,296 micro-organisms per cubic centimetre.

It is therefore most important that public attention should be called to the unsanitary state of those diary farms of which I have given a type. I am acquainted with many milk producing establishments whose surroundings and general sanitary conditions are really no better than that already referred to; the milk, cream, butter and other produce of such places, are all more or less liable to become tainted and infected by their foul surroundings, and thus become the medium for conveying to the human system organic matter and micro-organisms of the character previously shown; and a great, and sometimes mysterious danger to public health caused thereby.

On "The Iron Process, as applied to the Disinfection of Sewage in Barracks and Dwelling Houses," by Major CONDER, R.E.

ABSTRACT.

Invention by the late F. R. Conder, M.Inst.C.E., of a Self-regulating Chemical process for application to closed drains on various scales.

The proportional dosing of the sewage with iron in solution thus rendered practical at small cost. The result is the disorganization of the sewage into inorganic elements, producing a silt easily dried, and a pure effluent within requirements of Rivers Pollution Committee. The offensive odours destroyed and the bacterial germs killed, as shown by Government analysis.

House application, by an instrument called the "Ferrometer," intended for about ten people, and requiring to be filled and cleared once a month. This has been applied at Windsor Castle, Buckingham Palace, at various houses of the Marquess of Bute, and by the Duke of Wellington, Lord Salisbury, Lord Lorne, and in some 300 cases in country houses to the satisfaction of those who have adopted it.

Drain application.—At present the process is only working in England on a small scale. It was adopted at Chichester barracks by the War Office, in 1886, and paid for under

agreement that it should first be reported satisfactory by the commanding engineer. The number of persons treated is about 1000.

It was further adopted by the Admiralty at Eastney Barracks, Portsmouth, in 1889, and after six months' trial has been reported successful, and negociations commenced for applying it to 2000 persons. The Admiralty analyst reports the destruction of bacterial germs in the treated samples.

On the property of the Duke of Northumberland at Alnwick, it has been applied to the Castle and to 1500 persons on the property, and reported by the Clerk of the Works to be the best process with which he is acquainted.

At Grange-over-Sands in Lancashire, it was applied in 1889 to 300 persons, and the results found satisfactory. The Inspector of the Local Government Board having given a favourable report, the Local Board of Health was empowered to raise money for the development of the drainage system; and this having been carried out, the process is now being applied to the new drains, and has been reported successful.

In these cases the form of instrument consists of tanks and cones placed in pits by the drains, but the principle is the same as that of the household instrument.

Further applications on a larger scale are now commencing at Halifax in Yorkshire, and at Toronto and other places in Canada.

The advantages claimed for the process are—

1. That it can be applied immediately, without alteration of existing drains.
2. That it destroys the sewer gases from the point of application, and not merely at the outfall.
3. That the effluent may be discharged direct into any stream without injury to the water.
4. That the expense is very small and the application simple to maintain.
5. That the silt is inoffensive and has been shown to make a good manure.

The success of the method depends on the proper apportionment and correct position of the apparatus, and on the saving of labour due to the automatic action which secures a constant application. The difficulty hitherto found in dealing with a bulky and offensive sludge is thus overcome.

Dr. A. Carpenter (Croydon) rose to give a most emphatic denial to Major Conder's statements with regard to sewage farms. His

experience of sewage farms, extending over thirty years, was that as they applied the sewage so must they take off such an amount of soil water as would correspond with the amount of sewage applied. With regard to the use of iron he had found it not only very expensive, but the mischief resulting to the streams below was such as compelled them to give it up. Under certain circumstances no doubt there was nothing more efficient than the use of sulphate of iron, but the principle was one which ought not to be adopted with regard to the country at large. It was injurious to the interests of the country that the material that was contained in human sewage should be destroyed; such sewage should on the contrary be conveyed immediately to the soil set apart for its treatment, and then there could be no mischief resulting from its application. With regard to the question of open sewers he thought there was a minimum amount of danger with the maximum amount of fear. The fear was wholly with the public, but from an experience of thirty years he was satisfied that the mischief was of a very minor character, and it was far better he held even that some effluvium should escape through an open sewer than that there should be gases confined in the sewers themselves. He contended moreover that sewer gas was a misnomer, for in sewers properly constructed and washed out no such gas could ever exist. If they got the sewage on to the land prepared for its reception within three hours from its discharge there was no risk, for before the time arrived for it to do any damage the mischief was removed by the agency of the beneficent microbes. They dealt effectually with all injurious matter, and deprived it of its sting. To adopt any system that would do away with the influence of these beneficent microbes would be ten times more injurious than to get rid of these microbes, and it would be contrary moreover to the best interests of economy.

Mr. Woodruff (Brighton) thought we were somewhat backward in the disposal of sewage so far as country districts were concerned, and he considered Major Conder's suggestions were very applicable to such districts, and more especially in those of them where cesspools were continually overflowing. With regard to sewer ventilators, he presumed that Major Conder referred to street ventilators; he himself had had considerable experience in these matters, and in Brighton, he might tell them, they were working on the principle of closing up these ventilators and substituting for them ventilators at the tops of houses. In many cases they built large shafts at the rear of houses, whilst in others pipes were put up in front. With regard to sewage farms, he had recently been journeying in Germany and other parts of the Continent, and he believed he had visited all the sewage farms in those parts, and from his experience he considered Mr. Conder's opposition to sewage farms was wrongly based. What he called the desideratum of a sewage farm was sandy soil. Of course, he found that it depended a great deal on the position and locality, and all special conditions had to be dealt with in a special manner. Sewage

farms, he thought, ought to be considered on their merits and not condemned in the wholesale manner adopted by Major Conder.

Mr. William White (London) observed that all those who had heard Dr. Poore's address to the Sanitary Science Section of the Congress would fully agree with what Dr. Carpenter had said with reference to the false principle and false practice of eliminating microbes from sewage. They ought, on the contrary, to be made use of in the cultivation of the land. Though he could not pretend to treat in detail of sewage farms, he should like to say that clay was unsuitable for such farms, whilst sand, which had been spoken of as a good medium, was, in his opinion, the very worst. He thought too that Mr. Moule had made a great mistake in the principle he had adopted of mixing with the soil sand, ashes, and baked clay. The earthworm could not be cultivated in these materials, and in connection with sewage the earthworm as they knew was most valuable. He had seen Mr. Moule's process at Dorchester, and at his shed where the soil was absorbed there was emitted anything but a sweet odour, and if it had been within the limits of the town it would no doubt have been amenable to the sanitary authorities. As regarded the ventilation of sewers there was no generation of sewer gases in properly ventilated sewers. This suggested the question whether sewers could not be so constructed as to carry off their contents to certain pumping stations within a convenient distance of the town in order that the sewage might be made use of in a fresh state. In villages there should not be the same difficulties of disposing of sewage as in towns, for there it was competent to spread the sewage over the land. With regard to the ventilation of sewers in the street, the system of carrying the pipes up the houses mentioned by Mr. Woodruff appeared in the first instance to be satisfactory, but to carry away the whole of the effluvium they must adopt separate systems to ensure ventilation, because each pipe that ventilated near the lower part would take the current away from the upper part and it therefore appeared that the system brought under their notice by Mr. Woodruff was insufficient.

Sir Thomas Crawford (London) said that he had had some considerable experience of the ventilation of sewers, and he held that the great object of ventilating sewers was not to let out gases but to let in fresh air. The moment the ventilators in streets became offensive that moment they had an absolute proof that the sewer was not sufficiently perfect for its purpose. Their object then should be not to close but to keep open the ventilators, in order, amongst other advantages, that they could detect any effluvium that might exist. He quite agreed with all that had been said during the discussion on removing sewage to the soil. The great difficulty in this connection was in dealing with old towns, but the great principle everyone he thought could bear in mind, and that was to give in the disposal of sewer gases an absolute free current of fresh air.

Mr. H. H. Collins (London) rose to corroborate the remarks of the President of the Congress, and also drew attention to the danger of preventing the access of free air to ventilators. To him it seemed that to advocate the system of carrying up pipes to ventilate sewers was a confession that the sewers were defective. There had been some attempts to introduce this system into London, but it had been found very difficult to get permission to run the pipes up houses, and he did not think the system was ever likely to be firmly adopted either in London or the suburbs. Let the sewers remain open, and let them get a current of air to pass through them as frequently as possible; and as time went on the public at large would have less fear and more common sense, for keeping them open was undoubtedly the best means of keeping the sewers sweet. When there was a complaint about any sewer being offensive, they knew there was something the matter with that sewer; and knowing that, they knew also how to deal with the defect. So far as country houses were concerned, Major Conder's remarks would no doubt prove useful.

Colonel Jones (Carshalton), speaking from twenty-five years' experience, was able to endorse the remarks which had been made. The question of ventilating sewers was a very important one, and he did not hesitate to say that the notion that they could get rid of bad smells by carrying them up into the air was radically wrong. Far better was it that smells should remain on the surface, for then steps could be taken to set defects right.

Professor Roger Smith (London), the President of the Section, reminded them, with regard to this question of sewage, that they had an enormous number of old districts to deal with, and the difficulties in the way of establishing sewage farms in these places was very great. Indeed, many local authorities would not countenance them at all. They might therefore welcome any means of bringing about a better state of affairs than now existed, even if those means were not the best that could be employed.

Major Conder (Southampton), in reply, said that he belonged to an army corps which had had considerable experience in draining its barracks; and without wishing to express any opinion contrary to that of the professional scientific men who had been good enough to discuss his paper, he must say that it was always considered to be extremely unhealthy for any collection of soldiers to have a drain effluvium in the neighbourhood of their barracks. But apart from any dangers to health, odours in the street were very offensive to the inhabitants, who would hardly stop to enquire their possible advantages before doing everything in their power to get rid of them.

On "*The Disposal of the Sewage of London upon the Maplin Sands*," *by* Richard F. Grantham, M.Inst.C.E.

The great difficulty in dealing with the sewage of London is its enormous volume, nor is there any precedent for dealing with the sewage of a city with a population of several millions, increasing at the rate of more than 70,000 per annum.

In considering the methods for disposing of London sewage, we must be guided rather by the particular circumstances than by the methods which have been actually tried in smaller towns.

The quantity to be dealt with and the extent to which the present known methods are applicable, having regard to the fact that it is practicable to discharge the effluent into a tidal estuary, are the first questions which arise in the consideration of the subject.

The Royal Commissioners in their first Report on Metropolitan Sewage Discharge stated, that the average daily quantity for a few past years had been at the rate of 19,000 cubic ft. per minute. This is equivalent to a river 40 ft. wide at its water surface, 5 ft. deep, flowing continually at the rate of about 2 ft. per second. It is estimated also that in that quantity, there would be about 4,500 tons per diem of wet sludge, and about 900 tons per diem of pressed sludge in cakes. Finally, in order to prevent further pollution of the River Thames, the Commissioners recommended that some process of deposition or precipitation should be used to separate the solid from the liquid portions of the sewage, and that the solid matter deposited as sludge should be applied to the raising of low lying lands, or be burnt or be dug into land, or be carried away to sea.

The liquid so separated would not however, they thought, be sufficiently purified for its discharge at the present outfalls to be adopted as a permanent method of getting rid of it, and its further purification could only be effected by its application to land by means of intermittent filtration. They thought also that sufficient land of a quality suitable for this purpose existed within a convenient distance of the Northern outfall, and the liquid they suggested could be pumped up on to this land from the separating works, and after filtration allowed to flow into the river.

If, however, sufficient suitable land at reasonable cost could not be procured near the present outfall, they recommended that the separated liquid be carried down to a lower point of the river, at least as low as Hole Haven, where it could be discharged,

the liquid from the Southern outfall being taken across the river and the whole conveyed down the Northern side.

As a step towards the fulfilment of the first part of the Commissioners' recommendations, the London County Council has completed the construction of large precipitating tanks at the outfall on the North side of the river, and is building similar tanks on the South side, for the purpose of treating the sewage with certain chemicals, viz: lime and sulphate of iron in the proportions of 3·7 grains per gallon of the former, and 1 grain of the latter, to each gallon of sewage, and if necessary $\frac{1}{2}$ to $1\frac{1}{2}$ grains, or even 3 grains, of permanganate of soda to be added to each gallon of the effluent. But the Commissioners observed that in any precipitation process the liquid could only be allowed to escape into the river as a preliminary and temporary measure, while several eminent authorities, Sir Robert Rawlinson, Sir Henry Roscoe, Dr. Corfield, Mr. Baldwin Latham, Mr. J. C. Mellis, and Dr. Tidy, have pronounced these proportions insufficient for the purpose of effecting any appreciable degree of purification of the sewage.

In accordance with part of the recommendations the solid matter deposited as sludge was to be carried out to sea, and the London County Council give effect to this by conveying it thither ultimately at the rate of about 18,000 tons per week.

It will have been observed that under this system there are three things to be kept in view.

1. Treatment of the crude sewage by chemicals.
2. Disposal of the sludge.
3. The distribution of the effluent on land or its discharge into the river at Hole Haven.

Other schemes have been suggested, such as irrigation without any chemical treatment, deposition and filtration on Canvey Island, and lastly, the conveyance of the crude sewage to the North sea in a canal open for part of its length.

Seeing that so many authorities have agreed in condemning chemical treatment as insufficient of itself to effect the proper degree of purification, let us consider the further treatment recommended.

It is important, first of all, to ascertain what quantity of land is necessary for the absorption of so large a volume as 180,000,000 gallons per 24 hours—approximately the normal quantity of sewage, without allowing for increase or storm-water. The only area suitable near the northern outfall is a tract of land, the subsoil of which consists of gravel, lying between the Great Eastern Railway and the London, Tilbury, and Southend Railway, its eastern boundary being approximately defined by a line drawn through Romford, Upminster, Ockenden, and

Purfleet. But since the publication of the Commissioners' Report (1884), a new line of railway from Barking to Pitsea has been made between these two lines, enhancing the prospective value of that tract of land. The subsoil of the marshes adjoining the river consists of alluvium, and therefore they are not suitable for the absorption of so large a volume of liquid. The estimates of the number of persons whose sewage could be applied to each acre of irrigation or filtering ground have varied from 100 to 3,000, but the latter figure has been reduced by Mr. Bailey Denton, in order to secure permanency of effect, to 1,000. These figures, however, if adopted without reference to the soil of the land upon which the sewage is applied, and without reference to times and seasons, would be misleading, and are not borne out by the everyday experience of actual practice. The practical application of sewage, as illustrated by the following list taken from official and other reports, differs from these estimates, and it will be seen that even in cases of intermittent filtration, combined, as it mostly is, with broad irrigation, the sewage of 1,000 persons, taken at the ordinary calculation of 30 gallons per head per diem, is in excess of what has actually been applied for any length of time when the growth of crops is necessarily taken into consideration.

Name of Place.	Quantity of Sewage per 24 hours.	Gallons of Sewage applied per acre per day.	Soil.
Edinburgh	2,500,000	10,000	Subsoil, sea-sand.
Banbury	320,000	2,300	Stiff loam upon clay subsoil.
Bedford	700,000	4,516	Rich loam with gravelly subsoil.
Blackburn	1,500,000	16,000	Light loamy soil upon gravelly subsoil.
Chorley	500,000	5,747	Poor vegetable soil with stiff clay subsoil.
Doncaster	600,000	5,217	Light sandy land.
Leamington	800,000	2,950	Fine loam on subsoil of gravel.
Merthyr Tydfil	1,000,000	13,333	Fine loamy soil with gravelly subsoil.
Rugby	400,000	6,153	Gravelly soil upon clay subsoil.
Tunbridge Wells	650,000	3,000	Stiff loamy and light open.
Warwick	700,000	5,185	Stiff clay.
West Derby	723,000	3,500	
Romford (Breton's Farm)	......	1872–73—2438	Loamy gravel and sand.
	......	1874–75—2453	
	......	1875–76—2782	
Slough	......	3,047	Sharp gravel and sand.
Barnsley	700,000	16,886	Subsoil of loam.
Aldershot	156,800	1,960	Poor sand.
Croydon	3,000,000	11,540	Open soil upon gravelly subsoil.
Berlin (Osdorf & Heinersdorf)	863,132	3,116	Sandy soil.

The same Commissioners, after referring to the case of Kendal, remark, that "for a small number of people, say under 500 to the acre, the sewage may be applied as it comes, leaving the grosser matters to become amalgamated with the soil, but if the number be increased, the previous removal of the sludge would be desirable, and for 1,000 or more it would probably become absolutely necessary."

It cannot be shown by any process of filtration or irrigation, omitting the case of Kendal as exceptional, that a greater quantity than 16,000 or 17,000 gallons per acre (equivalent to rather more than an addition of $\frac{3}{4}$ in. every 24 hours to the rainfall) can be distributed on ordinary agricultural land without interfering with its proper cultivation.

It would not be safe then to provide a smaller area of ordinary land than 10,000 acres, and this does not include any large increase in the future.

The cost of the land and its preparation in the cases of Abingdon and Malvern as described by Mr. Bailey Denton in his work, "Ten years' Experience of Intermittent Downward Filtration," amounted to £286 per acre in the case of Hitchin, to £251 per acre in the case of Abingdon, and £225 in the case of Halstead. Probably, therefore, the cost of land and its preparation for the treatment of London sewage would not be less than £300 per acre, or £3,000,000 for the 10,000 acres. Besides this there would of course be the cost of conduits from the Northern and Southern outfalls, and the cost of pumping power to a minimum height of say 75 ft. above Ordnance Datum, without any allowance for increase.

Assuming that the population continues to increase at a similar or possibly even at a greater ratio than has been stated, and assuming the correctness of the above estimates, what provision can be made for future extension of the irrigation or filtration area? Nearly the whole of the gravel bed described having been utilised, the subsoil of clay of which the surrounding country partly consists, not being able to absorb liquid at the same rate, proportionately larger areas must be acquired. But it may well be doubted whether it would be expedient to devote so large an area of land in such a district to the perpetuation of what is regarded by many, rightly or wrongly, as a nuisance, and which certainly would be looked upon as detrimental to the value of the surrounding property.

Considering the strong consensus of opinion against the proposed chemical treatment, and, indeed, against any chemical treatment of the sewage, and in view of the difficulties already pointed out attending its disposal upon land, there would appear to be only two courses open: either that the liquid should be

discharged at Hole Haven, or that it should be dealt with on the Maplin Sands.

But if the system now being tried should not sufficiently purify the sewage, the nuisance hitherto complained of will be as offensive to Southend and other places as it is higher up the river. No advantage will have been gained by discharging the effluent into the river at Hole Haven, and the County Council will be compelled either to increase the proportions of the chemicals with which the sewage is to be treated, or to remove the outfall still further.

Now it is claimed, on behalf of the scheme for the deposition and filtration of sewage on the Maplin Sands, that that spot would afford all the advantages claimed for Canvey Island, together with the advantage of being much larger in extent and removed far away from Southend or any watering place. Further; instead of a fertile tract of land being rendered valueless for agricultural purposes, a piece of land would actually be added which, as will presently be shown, may be made exceedingly fertile and valuable.

The general line of outfall is somewhat similar to that proposed, in 1857, by Messrs. McClean & Stileman, and lately revived by Sir Robert Rawlinson; but it differs from the latter in some important details. The chief of these are:—

1. The conduit to the Sands would be covered all the way, and would have a uniform fall throughout.

2. While the whole volume of the sewage would be dealt with on the sands when reclaimed, the method of treatment would be so designed as to remove all ground of opposition on the part of those who are interested in the oyster fisheries of those coasts.

Commencing at the outfalls, it is proposed to establish additional pumping power at the northern outfall to the extent of about 1100 h.p., and to pump the sewage up to an aqueduct, comprising two culverts 15 feet each in diameter, the inverts of which would be laid at a level of 27 feet above Ordnance Datum at the outfall, and be carried with a fall of 9 inches per mile for a distance of about two miles, where a junction would be made with the sewer from the southern outfall. At the southern outfall, additional pumping power to the extent of about 1050 h.p. would be provided, and the sewage would be pumped through a syphon 9 ft. 6 ins. in diameter under the river to an aqueduct consisting of a culvert 15 ft. in diameter, commencing on the north side of the river opposite Crossness, and extending to a junction with the aqueduct conveying the sewage from the northern outfall.

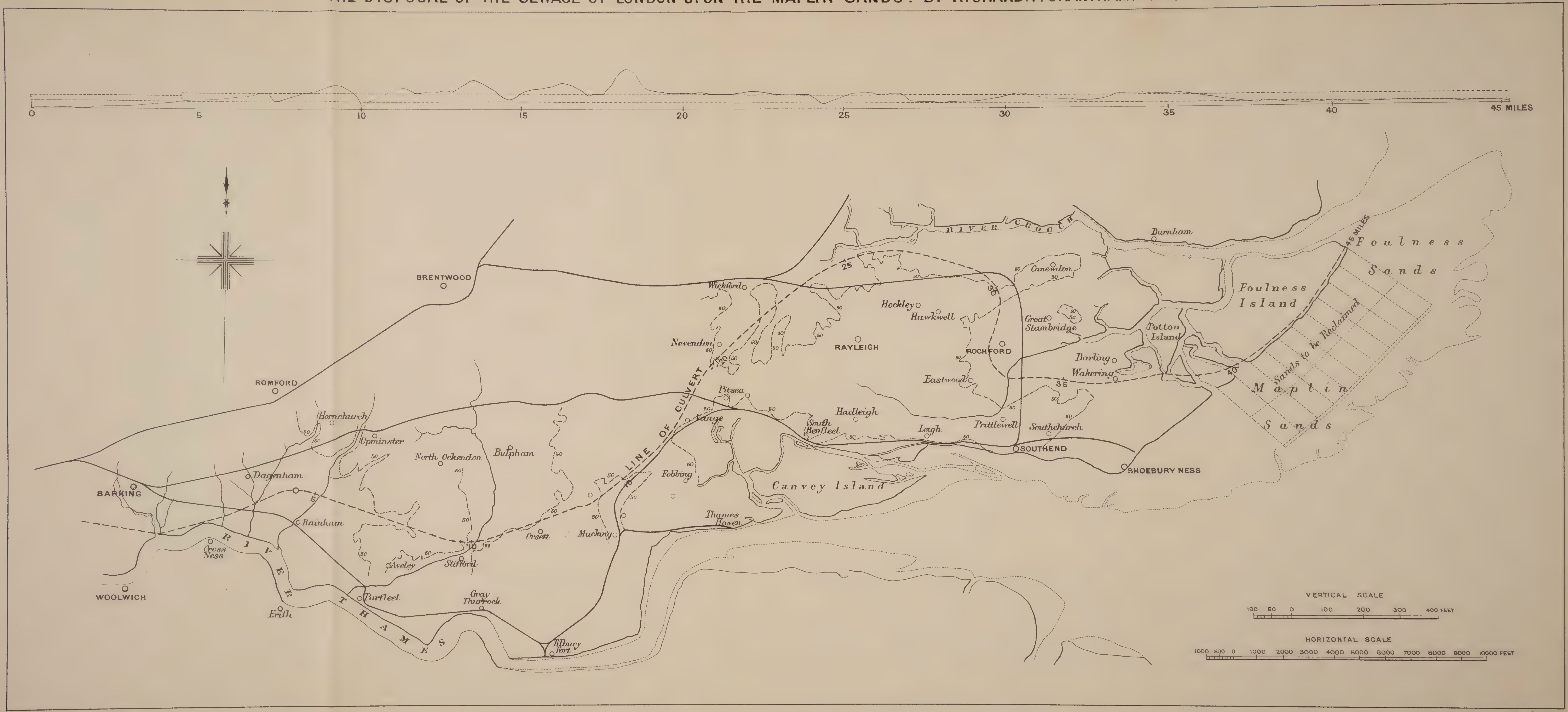
From this junction the aqueduct would convey the sewage

from both sides of the river a distance of about two miles in three culverts, each 15 ft. in diameter, to the upper end of the new outfall sewer, between Dagenham and Rainham villages. From this point the new outfall sewer would convey the sewage to the Maplin Sands along the line shown on the annexed plan.

The sewer which would be of concrete lined with two $4\frac{1}{2}$ in. rings of blue bricks would be 25 ft. in diameter, and would have a fall of 6 in. per mile without a vertical bend or syphon in the whole distance, the level of the invert at the lower end to be 4 ft. above Ordnance Datum. The line has been laid out to follow the contour of the land, so that as far as possible the culvert will be wholly underground, but at no greater depth than will afford a covering to the crown of the arch with the least possible embanking and tunnelling. The discharging capacity of the culvert when half full would be equal to 33,747 cubic ft. per minute, the velocity 2·3 ft. per second. At Foulness Island the conduit would be built parallel to and behind the whole length of the front sea wall with sluices in it at various points to admit of the discharge of the sewage on to the several plots of reclaimed land. It has already been shown that an area of less than 10,000 acres of ordinary agricultural land would not be sufficient for the treatment of the sewage, and although the soil of the area proposed to be reclaimed differs altogether from the soil inland, it would not be desirable to enclose less than 10,000 acres of it. It is proposed, then, to raise embankments, formed of clay from the line of the outfall sewer and sand from the foreshore, and to enclose the Sands in plots of 500 acres at a time. 4,750,000 cubic yards of material it is estimated would be dug out in the line of the proposed conduit, while there would not be more than about 2,000,000 cubic yards required for making the embankments, assuming that they were made ten feet wide at the top and raised to a level of eighteen feet above Ordnance Datum. About 1,750,000 cubic yards would be required for the concrete in the construction of the conduit, and it is expected that this would be found in the excavation. The material for the embankments could be economically transported from the spot where it would be dug to its destination in trucks running on lines of rails laid within the conduit itself as the construction proceeds, the diameter being sufficient to admit of a line of rails each way, up and down. On the verge of the sea frontage of the newly-reclaimed land a channel for the effluent water would be built, whence the effluent would be discharged through various outlets into the deep Swin Channel.

To determine how the reclaimed area should be best laid out for the treatment of the sewage, it must be shown what might be its exact capacity for absorbing and purifying sewage.

THE DISPOSAL OF THE SEWAGE OF LONDON UPON THE MAPLIN SANDS. BY RICHARD. F. GRANTHAM. M. INST. C. E.



London. Stanford's Geog[l] Estab[t]

Now, under ordinary circumstances and with due regard for the cultivation of crops, it appears, by the table already quoted, that the greatest quantity of sewage applied to agricultural land does not exceed 17,000 gallons per acre per 24 hours as the regular daily average. But the Maplin Sands present a surface different from ordinary agricultural land, and with an efficient system of arterial and under-drainage, would answer the purpose of a filter bed. The Craigentinny meadows, which receive the sewage of Edinburgh, afford an analogous case, so far as the soil is concerned, and have become, from the constant application of sewage, very fertile, although, as they are not prepared in any way for its reception, the effluent is not completely purified. The quantity applied there per acre per diem, as shown in the table, is 10,000 gallons. But in very porous soil, such as that at Merthyr Tydfil, Kendal and Abingdon, 50,000 (according to Mr. Bailey Denton), and 200,000 gallons have been respectively daily absorbed per acre, although such quantities render cultivation impossible.

Taking as an extreme case the average rate at which the water of the London companies is filtered upon carefully prepared filter-beds of sand and various thicknesses of gravel, we find that the volumes absorbed by each acre are at the rate of from 1,500,000 gallons to 2,000,000 gallons per acre per 24 hours.

Dr. Frankland's experiments, which led to the practice of intermittent downward filtration, showed that volumes varying from 42,592 to 95,832 gallons per acre per 24 hours, according to the nature of the subsoil, could be purified in passing through subsoil drained 6 ft. deep, although these were simply laboratory experiments.

Within the last few months the Massachusetts Board of Health has issued a report embodying the results of its recent experiments on the filtration of sewage. According to this, sewage may be a good deal purified by being allowed to pass intermittently through a filter of open sand, so that the surface by becoming dry may allow air to enter the filter, and filtering beds of sand covered with soil may be much increased in efficiency, by digging trenches along a slight incline in the bed and filling them with coarse sand. When exposed to cold and snow, the filtration was found to be imperfect at even the moderate rate of 30,000 gallons per diem. Where protected from cold and snow the sewage was passed through the filters at the rate of 30,000, 60,000 and 120,000 gallons per acre per diem, and at these rates the ammonia showed that 97, 94 and 80 per cent. of the impurities were removed. Upon increasing the rate of filtration to 180,000 gallons, the percentage of ammonia

increased, but did not exceed 2 per cent. of those of the treated sewage.

Before applying these figures to the scheme proposed in this paper, it may be remarked that the effluent need only be so far purified, that after admission into the great body of tidal water in the Swin Channel, it will not endanger the Oyster Fisheries, or cause a nuisance to Southend or Burnham.

A somewhat long experience of arterial and under-drainage in the Lincolnshire marshes, where the surface and subsoil are silt originally reclaimed from the sea, has shown to what extent the absorbing power of subsoil may be increased. It would be easy by trying on the Maplin Sands a system similar to that proved in Lincolnshire, to make them capable of absorbing the quantities which it is proposed should be discharged upon them. The reclaimed areas on the Maplin Sands would be divided into fields of say about 100 acres, by the intersection of main arterial drains, which would receive the discharge from the underdrains to be laid in each field. The excavation from the arterial drains within the reclaimed area would be used in strengthening the embankments.

The surface and subsoil on the Lincolnshire marshes is silt, as already stated, of more or less density. It is formed by a very slow process of accretion until it rises above the level of ordinary high tides. Then it gets gradually covered with grass and in time becomes exceedingly fertile, and has been let, as soon as enclosed, at £3 per acre. In a somewhat similar manner, by the application of sewage matter, it is believed the Maplin Sands may become fertilized; and indeed, the Edinburgh sewage meadows seem to demonstrate the feasibility of converting them into agricultural land.

From the above examples we may conclude that upon such soil, with a proper system of internal drainage, a quantity of sewage equal to 50,000 gallons per acre per day may be readily absorbed and fairly purified over that portion of the reclaimed area which it is proposed should be devoted to filter beds. These filter beds, it is suggested, should cover 4,000 acres divided in their working into two equal areas to be used intermittently, while the remaining 6,000 acres would without difficulty absorb 12,000 to 15,000 gallons per acre per 24 hours, and at the same time admit of the cultivation of crops. In view of future needs, a still larger area might be apportioned to filter beds.

The estimate for the work, exclusive of the cost of land and foreshore rights, is £4,500,000. The area of the land through which easement would be required would be about 300 acres. The working expenses of cultivating the enclosed irrigated area

would, it is anticipated, be in great measure covered by the returns of the crops yielded.

There would of course be no difficulty in delivering any sewage from the outfall sewer to farmers who might wish to apply it to their land.

The disposal of the sewage of London on the Maplin Sands is an old idea, but recently the owners of oyster fisheries have been much agitated at the suggestion of it, although no steps have been taken to place it a stage further than suggestion.

The scheme herein proposed would, it is believed, so far purify the sewage as to render it admissible into the Swin Channel without fear of injury to the oyster fisheries or to any other interest.

It would be impossible within the limits of a single paper to describe in detail a scheme intended to deal with so large a volume as the sewage of London. This description of the outline of such a scheme may, it is hoped, contain suggestions worthy of reflection and discussion.

Mr. J. LEMON (Southampton) drew attention to what had been done by the Metropolitan Board of Works and the London County Council, reminding them that precipitating tanks were being constructed at a cost of a million sterling, whilst the sludge was being taken in barges out to sea. Was this large cost, he asked, to be thrown away? Ought they not to consider whether they should utilise these things? He considered it an unscientific system to take sludge out to sea. There was no reason whatever, he held, why London sewage should not be treated by chemicals, and by their adoption a sufficiently pure effluent could be obtained to render the discharge also sufficiently pure for all practical purposes. As to the disposal of sludge there should be no difficulty. It ought to be transmitted to some suitable soil and there so dealt with, as at Birmingham, as to make it form a portion of the land itself. It was far better, he maintained, to deal with a small quantity of sewage and convey it to a place where it could be easily disposed of than to go to the enormous cost of conveying the whole of the sewage of London to the Maplin Sands. And when they got it there could it be finally disposed of? He believed a great mistake had often been made in taking it to unsuitable places where it could not be properly disposed of, and this error he thought would be likely to be repeated at the Maplin Sands, for unless the land had such drainage as to ensure the oxidation of sewage there could be no purification at all. And what about increasing the County Council rate to carry out this large scheme? The cost of conveying the sewage would alone be four and a half millions, and this sum did not allow for the purchase of the land or the working expenses, which he estimated at £100,000 a year. The yearly payment of interest on the outlay he put down at £250,000 so

that Mr. Grantham's scheme would cost the ratepayers not less than £350,000 a year. That was a sum which the ratepayers of London would not approach with a very light heart. For himself he would propose to convey the sludge through pipes to Canvey Island, which was only half the distance of the Maplin Sands and dispose of it there. Moreover, he considered it quite possible so to filter the effluent as to bring it to a high degree of purity and then discharge it into the river. Although he thus differed from Mr. Grantham he quite recognised the importance of his paper, and he accordingly moved a special vote of thanks in that he had taken so much trouble to introduce it.

Colonel Jones (Carshalton) seconded. He considered that the only trouble about the scheme laid before them was its immense cost and the reclamation of land that it would necessitate. For this reason he also considered that Canvey Island would be the better place of the two, and it had this advantage over the Maplin Sands—its land was agricultural and alluvial, whilst the work of reclamation was already done. Again, the cost would be much smaller; he should think it would not exceed at Canvey Island £30,000 a year. So he advocated this as a half-way house, and he thought it would make a very good compromise.

Dr. Carpenter (Croydon) thanked Mr. Grantham for dealing with the matter in so practical a way. There were many excellent points in his paper which should commend themselves to the consideration of the County Council, but there were some points which were based to some extent on mistakes, and mistakes which would have to be considered by those who faced the enormous difficulty of dealing with such an immense mass of sewage. One great mistake, was the proposal to bring all the sewage to one outfall. Certainly there should be more than one, and he considered that fifty sewage farms would be better than bringing such a huge mass to one point. He rather believed that the compromise mentioned by Colonel Jones would probably be that which would come about, for it was absolutely necessary that sewage should go to suitable land, and so assist in the production of meat and milk for the inhabitants of the country. He thought too that they might adopt such an arrangement as would utilise the tanks that had already been formed. Certainly the principle of so applying sewage to the land as to increase the luxuriance of vegetation, ought to be adopted by London as it had been by Birmingham. With regard to the cost, what was £350,000 a year, when the end to be gained was the surmounting of so great a difficulty? Why, a threepenny rate would do it. But he did not think there need be this sum to be paid annually, for by making sewage of use to the soil, a sufficient return would be realised to pay all working expenses. If some skilful engineer would only face this question in the right way and provide for the distribution of sewage over several acres, no matter how far from London, they would, he believed, get rid of their difficulties and prove moreover the means of producing cheaper food; an end which would be of the utmost advantage to the interests and welfare of the nation.

Mr. R. F. Grantham (London), in reply, said that he did not claim for his scheme that it was unalterable. In fact, he admitted that it had only been thought out in a rough and general way. Mr. Lemon had asked if, in the adoption of the scheme suggested, the tanks which had been formed at a great outlay were to be done away with? He did not think so. There would have to be tanks for giving effect to his scheme, and so at any rate they would not be entirely done away with. As to the treatment of sewage by chemicals, he would be very glad if it could be successfully adopted. They had been waiting for years for some satisfactory scheme, and Mr. Brigden had put forward one, but it had by many authorities been condemned, and at present they were waiting still. Then with regard to the proposal of pumping up sludge as at Birmingham, it had to be remembered that the locality made all the difference. The sludge there was very thin, and what was possible at Birmingham, might not prove successful at London. Where so great an amount was concerned they must not consider the question of cost, and he was sure that if they could get a fairly good scheme, London would not stop at that. There was one point which he thought Mr. Lemon hardly realised, and that was the quantity of water to be used. It was all very well to filter sewage, but the quantity of water to be applied to the land had to be considered, and as he had shown large quantities were not applied. With regard to Canvey Island, he could only say that he had considered the question, and he thought it would be much better if Canvey Island were in the direction of the Maplin Sands. In considering Canvey Island, they had also to consider that popular resort Southend, and he felt sure there would be great and successful opposition to the Canvey Island proposal.

On "Black Ash Waste, and its Application to the Treatment of Sewage and Foul Water," by Mr. John Hanson.

Mr. John Hanson read a paper on the above subject, with a preface that it might be presented in quite a humorous and piquant form had he the gift of poetry and classic illustration like some newspaper writers. But they were met rather for instruction than entertainment, and so he only proposed to deal with it in the interests of the public health as a practical sewage chemist. A Greek title might make it more attractive, yet he should show, by plain facts, that his process was adopted to utilize mountains of chemical waste, and to restore the rivers of England to the sport of the angler and the enjoyment of the naturalist, while fulfilling its purifying function on sewage.

Black Ash Waste, he proceeded to explain, is a by-product in the manufacture of alkali, or common soda, in the making of one ton of which four tons of the waste were produced. The residual was principally sulphide of calcium, which, it should be noted, is a polluter, and not a clarifier, of water, so that the waste itself was worse than useless—the virtue was in his extract. By his process the sulphides are metamorphosed into sulphites and hypo-sulphites—the strongest and best purifying chemical known. This disinfectant is disintegrated, pulverised, and oxidised under his patent, and is known as Hanson's "Sulphurous Powder." Its effects were prompt, marked, and remarkable, as seen in the reports of analysts, engineers, and others.

A given quantity of the powder mixed with water and well agitated, is allowed to flow with the polluted water into a precipitating tank in conjunction with milk of lime. The first result is, that the sulphurous powder absorbs one atom of oxygen from the foul liquid, and by so doing sulphurous acid gas ($H_2 SO_3$) is at once formed, this being equivalent to the effect of burning brimstone under water. The fumes permeate the liquid and destroy all microbes (or germs of zymotic disease), completely ridding the effluent of all organisms whatever. The action of the lime is to contract the solid particles in suspension, and by making them heavier in proportion to their size, to increase their specific gravity, and so precipitate them as sludge. Caustic lime made the effluent alkaline, destroying fish, incrustating boilers, and hardening the water so that it could not be used again in many manufactures. The combination of his two chemicals took up another atom of oxygen, converting the result into sulphuric acid ($H_2 SO_4$), which combined with the causticity of the lime, and threw down the hydrate of lime in the form of sulphide of lime, and thus rendered the effluent neutral as well as pure. The result, in short, complied with the Rivers' Pollution Act in a way surpassing all other attempts. The standard of purity he set up was a commercial one, and cost only 6d. per head of the population per annum. As to drinking the effluent, that too could be provided for, though the luxury would be a rather costly one.

In proof of these statements he invited an inspection of his works, more in number than any other sanitary firm could boast of. There are some half-dozen different solutions of the sewage difficulty offered to the public, with chemical materials of the most diverse kind. And whereas public reports showed that all, or nearly so, of these different methods had been abandoned somewhere, it was a significant fact that Hanson's system had in no instance been abandoned when fairly tested.

This process defeated the A.B.C. in open competition at

Leeds in July, 1876, the effluent being (according to the Leeds press quoted) colourless, inodorous, and of a higher standard of purity than Government required.

In the same year it was adopted by the Tong Local Board, and Mr. Edward Croft, the Chairman of the Board, reported that "the method has always been, and is acknowledged, by the most eminent chemists and engineers, to be the simplest, cheapest, and most perfect ever known; and the Tong sewage is of the vilest type. Mr. Hanson produced a bright, clear, inodorous, and almost pure effluent, said to be the purest in the country."

In 1880 he delivered the Tweed from the pollution of Hawick.

In the following year he put up Sewage Works at Golcar, and others at Crimble, at a cost of £3,220, still in use with his process.

Subsequently Aldershot required his treatment, and afterwards he undertook large contracts at Tottenham, Leyton, and Canning Town (on the Lee), Silver Town (on the Thames), and elsewhere.

The Lee was notorious for its pollution, causing litigation and legislation, and ruining all trades that had depended upon it. In six months (according to the *Daily Chronicle* quoted) all this was changed, and Major Lamorock Flower, as Sanitary Engineer to the Conservancy Board, reported that on their annual survey of the river, they expressed their "unqualified delight at its changed condition, mainly due" (as the Major pointed out) "to the treatment of the Tottenham sewage by the sulphurous powder." In a Select Committee of the House of Commons on the state of the river, Mr. W. C. Young, the Consulting Chemist of the Board, gave his preference to Hanson's process (in answer to questions by Sir Henry Roscoe), particularly because "the effluent was perfectly free from microscopic organisms."

As to the Leyton works, he quoted from the *Eastern Mercury* the testimony of Mr. J. G. Browning, Assistant Engineer to the Local Board, that they were "the finest in England, if not in the world;" and that "the most celebrated engineers in the country," on inspecting them, "go away with a very favourable impression of the manner in which Leyton disposes of its sewage by Hanson's Sulphurous Powder."

After mentioning West Ham and his "detective water-wheel" near Lee Bridge, Mr. Hanson dealt with the disposal of his sludge (which Dr. Munro, F.C.S., had said was the second in manurial value, 28s. 6d. per ton), stating that when not wanted as a fertilizer he carbonized it in a destructor.

In drawing his remarks to a close Mr. Hanson advised great caution and personal enquiry on the part of those seeking deliverance from the sewage difficulty, whereby they might save the waste of millions. "Beautiful sewage-farming" was a thing of the past. The watery ways of our weather give the poor farmer 'liquidation' enough without irrigation. Mere precipitation and filtration was but toying with pestilence.

Major LAMOROCK FLOWER (London) said the author of the paper had enabled him to state, that the Lee was no longer the narrow dirty ditch it was when he took charge of it twenty years ago. He endorsed all Mr. Hanson had said as to the value of the treatment of sewage, by his mode of dealing with the residuum product, and he mentioned that at Tottenham where the river had been very filthy, Mr. Hanson's method had been adopted, with results so satisfactory that his own Board wrote to the Tottenham Local Board to record their great sense of satisfaction. When the water was drained out in the portion of the river where Mr. Hanson's method was adopted, it was found that the bed of the stream was singularly clear, whilst at Hertford, where it had not been adopted, the bed of the river was in the most filthy condition. At Hertford, moreover, sulphate of iron had been used, which showed that this compound was not always to be relied upon.

Mr. WILLIAM WHITE (London) said it seemed to him that Mr. Hanson's method might very well form a subject for the investigation of the Institute in London.

Mr. H. H. COLLINS (London) pointed out that whenever a Certificate of The Sanitary Institute was given to an invention, it was only given after the Judges had made a careful examination, and had tested it for themselves. In short, The Sanitary Institute Certificate was a thoroughly *bona fide* document.

Mr. HANSON (Wakefield), in reply, said that if a cup full of his sulphurous powder was taken and a little acid poured on it, it would so fumigate the room in which they were assembled, as not only to drive out all the parasites, but to drive them out too. There was no difficulty, he held, in treating the sewage of London by his method, and no subsequent treatment would be required.

On "*Artisans' Dwellings*," by FRANCIS HOOPER, A.R.I.B.A.

THE construction of "Artisans' Dwellings" is a subject well deserving the attention of the architectural section of this Congress, not alone in reference to sanitary fittings and drainage, but also with regard to locality, surroundings, and disposition of plan, comprehending as these dwellings do the housing of a vast section of the entire population.

It is not necessary for me to enlarge upon the present grievously unsanitary conditions of the houses occupied by large numbers of artisans and their families in our densely crowded cities—conditions incidental not solely to overcrowding, but to the fact that houses old and dilapidated, constructed often for a class of tenants whose circumstances were entirely different to the present occupants, and render the accommodation quite inadequate to the requirements of humbler households.

The provision of healthful and comfortable "*homes*" should be the aim of all who undertake the housing of artisans.

Many of my audience must have observed the spreading fashion for the erection of so-called model tenement dwellings; I use the word "fashion," but might be more correct in calling it "fever," as speculators have found that here, for the present at least, money is to be made, and building plots small and large, suitable and unsuitable, are being covered with residential flats and artisans' dwellings, which I believe will be found dangerous encumberers of the ground very soon after the brightness of the tuck-pointing outside and of the machine-printed wall-papers inside has worn off.

Regarding the general question of housing artisans in large towns, many economies are effected in tenement buildings, in that, one roof, one drain, one staircase, one water and gas service, suffice for many households, and whilst all are in good order all benefit alike; but should accident occur, defect arise, water fail, a drain choke, or a fever break out, the evils spread, and all are liable to suffer. It is most essential therefore that in such thickly populated buildings, which are sometimes as much as six storeys high, the sanitary arrangements should be of the best construction, and all apparatus and fittings of the most substantial kind. Hence I view with more anxiety the activity of the private speculator in tenement dwellings, than of those who erect villas in our suburbs the ill-repute of which has long ago become a by-word.

Relation of Rent and Wages.

In considering the structural requirements of "Artisans' Dwellings," it is necessary to determine the class of artisans whose requirements are to be met, as the accommodation and household fittings are regulated by the rents obtainable from the tenants. I propose now to confine my remarks to block or tenement buildings in thickly-populated towns suitable for artisans whose weekly wages range from 30s. to 50s.

Evidence given before the "Royal Commission on the Housing of the Working Classes, 1885," goes to show that in a large district in London, where special enquiry was made, upwards of 88 per cent. of the working men were found to pay more than one-fifth of their earnings in rent, and that the average rent of one room, let as a separate tenement, was 3s. 10¾d.; of a two-roomed tenement, 6s.; of a three-roomed tenement, 7s. 5¼d. The Report of the Commission adds, "Corroborative evidence is not wanting that the witness erred, if at all, on the side of moderation."

The scope of my subject is therefore confined to tenements rented from 6s. to 10s. per week; and here it may be well to remark that the weekly income of an artisan with a family is not arrived at by simple enquiry as to the amount he himself earns; for in an industrious family not only the wife, but frequently the elder children, contribute to the weekly earnings.

Selection of Building Site.

In selecting a site for Artisans' Dwellings, it is of the highest importance to secure sufficient area, well-drained subsoil, and suitable shape.

From measurement of the best-arranged buildings of this class, I find that these occupy on an average about one-third of the entire site, thus leaving two-thirds for air, light, approaches, and recreation.

It is important, from a commercial point of view, that the buildings should be in proximity to the factories, wharves, or other places affording employment for the tenants, or that cheap and rapid means of transit either by rail, omnibus, or tram-car, should exist.

Open Spaces.

It would appear from an inspection of a large number of existing dwellings erected both by private individuals and limited liability companies, that the front of every block should

either abut upon, or else face a public thoroughfare, and thus afford a more cheerful outlook than the alternative courtyard. It further seems that where no rights of light exist to limit the height of building, builders are tempted to carry up their work to a height which seriously injures the light and wholesomeness of the lower tenements.

Where buildings occupy more than two sides of any enclosed space, it is most desirable to avoid the abutting of two buildings at the angles, which invariably darkens certain of the staircases and rooms, and to leave an open space between to permit the free circulation of air, and avoid stagnation, which tends to create disease.

It is not always possible for the architect to choose the aspect of his building, but an attempt should be made to secure frontages to east and west, so that the windows may receive the horizontal rays of the sun, whilst the vertical rays strike down into the courtyard and street.

Approaches and Entrances.

The development of any large scheme usually involves the repetition of a certain arrangement of rooms around a common staircase, which gives access to the several tenements, each of which, as far as possible, is self-contained.

The entrance may be formed at the back or front of the block, but where the staircase is built against an outer wall there are certain advantages in having the entrance at the back, as the stairs are more private, and the whole of the front wall is available for rooms.

In such cases the courtyard is entered by an archway through the front block, and the tenants are more directly under the control of the superintendent, whose office may be at one side of the principal entrance.

The several blocks will vary from 28 ft. to 36 ft. in depth, according to plan, and the frontage from 45 ft. to 75 ft.

Height of Buildings.

The height of the buildings should not exceed five storeys above the ground, on account of fatigue in ascent and obstruction of light and air. Shops may occupy the ground floor in busy thoroughfares, and will probably be let in conjunction with a cellar below, or perhaps a tenement behind or above, thus helping to augment the revenue.

Courtyards.

The courtyards may with advantage be levelled, and spread with a 9 in. layer of cement concrete, laid to falls for drainage, and finished on the surface with a coating of compressed natural asphalt or tar-paving, which latter is fairly efficient and much the cheaper of the two materials.

Staircases.

The staircases should be built against an outside wall, so that ample windows may light them and that a shaft may be avoided, which would spread fire upwards should such break out in the building.

Fire-resisting materials should in all cases be used for staircase construction, and for this purpose gas breeze concrete is more reliable than stone, for both treads and landings.

The height of the storeys in the clear should be about nine feet; thus, if the rise be seven and a half inches, two short flights of eight steps will extend from floor to floor, and the tread with nosing need not exceed eight inches.

The width of the staircase should be not less than six feet nine, which, with a nine inch brick newel, will allow of treads three feet wide; winding steps should on no account be tolerated, being both dangerous and difficult to light.

A solid newel should always be introduced, as it increases the strength of the stairs by giving the treads a bearing at either end; offers resistance to, and mitigates the spread of fire from floor to floor by the staircase well; prevents tenants from seeing one another and talking from floor to floor, and thus adds much to the quietness and privacy of the building.

Open Balconies.

With a view to reduce the number of staircases, and to avoid the formation of internal corridors of approach to several tenements, external galleries or open balconies have in many instances been constructed, but these must on no account be arranged on the side next a public thoroughfare, nor should the balconies of two parallel blocks be towards each other.

This arrangement can not, however, be commended as the rooms are deprived of much light, and unless the rooms are entered directly from the balcony, there is of necessity a loss of floor space by the formation of a passage-way.

Internal Corridors.

Internal corridors are specially to be avoided, as they are most difficult to light, and are consequently but rarely kept clean. They further afford shelter for loafers and gossipers, and hence are morally injurious.

It is well that the window openings upon the staircase should be unglazed, in order to secure ample ventilation, and to prevent the transmission of foul air or disease; each opening being protected by a strong iron guard-rail.

The walls of the staircases should be lined with some hard impervious substance which can be readily washed.

Glazed bricks are very efficient, but a tinted granolithic cement dado 4 ft. high presents a more homely effect, the wall above being plastered and coloured.

A strong handrail should be provided, and may be formed of $1\frac{1}{2}$ in. wrought iron gas-piping in straight lengths fixed about 2 in. from the wall by means of short brackets.

The front door of each tenement should open immediately upon the staircase landing, and, where space permits, an entrance lobby should be provided to increase the privacy of each dwelling.

A good average height from floor to floor is 10 feet, giving about 9 feet in the clear; and, bearing in mind that the Public Health Act requires 300 cubic feet of air for each adult, and 150 feet for each child, as a minimum in the sleeping room, it is necessary to provide floor space equivalent to at least 6 ft. 6 in. by 5 ft., and 5 ft. by 3 ft. 3 in. respectively.

Shoots for Dust and Ashes.

Shoots for the disposal of household dust and ashes may suitably be formed in the corner of the half-landings of the stairs. These shoots should be shafts about 9 in. by 9 in., formed in the brickwork rendered internally in cement, discharging at the bottom into a dust cellar or a movable receptacle, and continued up through the roof for ventilation. The hopper-door on each half-landing should have side cheeks and a metal flap inside to prevent the dust from being blown back before the door can be closed, thus making dirt and litter on the stairs, and it also should be made self-closing.

Each landing should be lighted at night with a gas jet of about 20-candle power; the frame of the lamp being easily removable for cleaning and repairs. A very neat pattern, used by the Improved Industrial Dwellings Company, consists simply of a front hooked on to buttons on the wall; the glass

is in narrow slips, not puttied in, but secured in a groove, and the enclosure is ventilated by a short pipe carried through the concrete landing above, and finished on the top with a metal hood.

Internal Arrangement of Tenements.

The internal arrangement of the tenement should as far as practicable assimilate to that of a well-planned country cottage, the size and number of rooms depending upon local circumstances, wages, and requirements.

Single-room dwellings are in request in some districts, but I find in the Peabody Buildings in Westminster most of the single rooms have been let together in pairs, the largest demand being for two and three rooms, which, for economy of space, are arranged to open the one from the other.

A convenient size for the living-room or kitchen is eleven feet wide by thirteen feet from front to back; the fire-place being so placed as to allow of a bedstead at the back of the room, if required. The windows should be of ample width (three feet six inches at the least) and should extend to within six inches of the ceiling to obtain the utmost light and ventilation. The sashes may be made in three heights; the lower being fixed for the protection of children, obscured glazing answering as a window blind; whilst the upper ones are double, hung with pulleys and weights. The cooking-range should not be less than 3 ft. in width, and fitted with an oven; all parts subject to heavy wear, such as the fire-bars, draw-out fret, drop-bars, trivet, etc., being of wrought iron. The following fittings should also be provided: a fixed dresser, with shelves and cup rails; a food store, ventilated if possible from the external air; a coal-bunker, formed with a sliding door or top flap; a sink of Bristol glazed ware; a wooden drainer; and a plate-rack.

In the Peabody Buildings and many others of similar type the sinks as well as the W.C.'s are on the staircase landings, used jointly by the occupants of two or more tenements, and open to the constant inspection of the superintendents.

Laundries.

In addition to the sinks, a laundry is frequently provided on each storey for the general use by turn of the several tenants, furnished with one or more coppers, and teak or stoneware washing-troughs, and, as in some of the recently erected buildings of the "Artisans, Labourers, and General Dwellings

Company," an enamelled fire-clay bath is also provided, to which cold water is laid on, hot water being obtained by each tenant from a copper. From many enquiries I find that baths are but little appreciated, and appear likely to continue so with the present race of tenants.

In order to obviate annoyance from the smell and escape of steam from these laundries, the Improved Industrial Dwellings Company have for a long time past been constructing them on a large scale, on the flat roofs of their buildings, where steam freely escapes, and there is ample space around for drying the wet linen. This example has been followed by the Peabody Trustees in their buildings in Peter Street, Westminster, where, in addition, is provided a covered drying-ground, which can be kept under lock and key and used by the tenants in turn for 24 hours, viz., 8 a.m. to 8 a.m., and is much appreciated by them.

The Trustees still provide only one W.C. and sink between two families, whereas the former Company appears to make it a principle that each tenement shall have its W.C. and sink contained within itself.

Two distinct arrangements of plan are shown in the accompanying illustrations (page 208). In the one case the sink is placed in an enclosure opening from the living-room, having a window, and comprising also a food and coal store, whilst the W.C. is entered from a lobby, and is both lighted and ventilated by a window to the outer air over that of the sink enclosure.

In the second case the front enclosure of the living-room is set back from the general wall-line to form a balcony, upon which is the W.C., coal store, &c.

The entrance-lobby, which adds greatly to the privacy and comfort of the tenement, should be provided with hat and coat hooks, and the rooms should have wooden rails on the walls for pictures or prints, to prevent as far as possible injury caused by driving nails into the plastering.

Bed-rooms.

The bed-rooms will vary in size, but one at least should be as large as 13 ft. by 9 ft., and a hanging closet for clothing should be provided in each. Fanlights over the doors prove most useful ventilators, and if glazed with obscured glass prevent dark passages. Every bed-room should have a fireplace so planned as to allow a clear space round the bed of at least twelve inches, and the grates should be of fire-lumps, with fuel space of about 8 in. by 4 in. and 10 in. deep, the mantel and shelf being of cast iron, as the most durable material for such buildings.

I found in some dwellings in Rouen gas services provided

for cooking; a provision which I consider worthy of imitation in this country.

In many buildings Venetian blinds are provided by the proprietors; these present a more tidy and uniform appearance externally than roller blinds, and are a source of economy to the tenant, who would otherwise have almost invariably to provide himself with new roller blinds on entering.

Each front door should be provided with a strong lock, varying in pattern throughout the building; also with knockers and spring letter-plates, and should be legibly numbered.

Window-gardening may be encouraged by providing wide sills, on which pots and flower-boxes may be placed, thus assisting to relieve the monotony of the *façade.*

Roofs.

Where roofs are flat, the staircases should give direct access to them, and should be finished with a solidly-constructed bulkhead.

Close guard-rails should be fixed around the roofs at least 5 ft. in height, mounted on a solid parapet, for the protection of children and adults.

The construction should be of iron joists, cement and coke-breeze concrete, finished on the top with asphalt or tar-paving. The surface should be laid to sufficient falls to secure ample drainage; the floors of the laundries, when constructed on the roof, should have channels to carry off the water quickly from the troughs, &c., wooden lattices being provided for the women to stand upon whilst at their work.

The general unsightliness of a flat-roofed building has been mitigated by the Improved Industrial Dwellings Company in their new buildings near Grosvenor Square, by constructing the topmost storey with an almost vertical mansard roof, covered with tiling, above which is the stone curb carrying the guard-rail, supported by an iron purlin running parallel with the front wall.

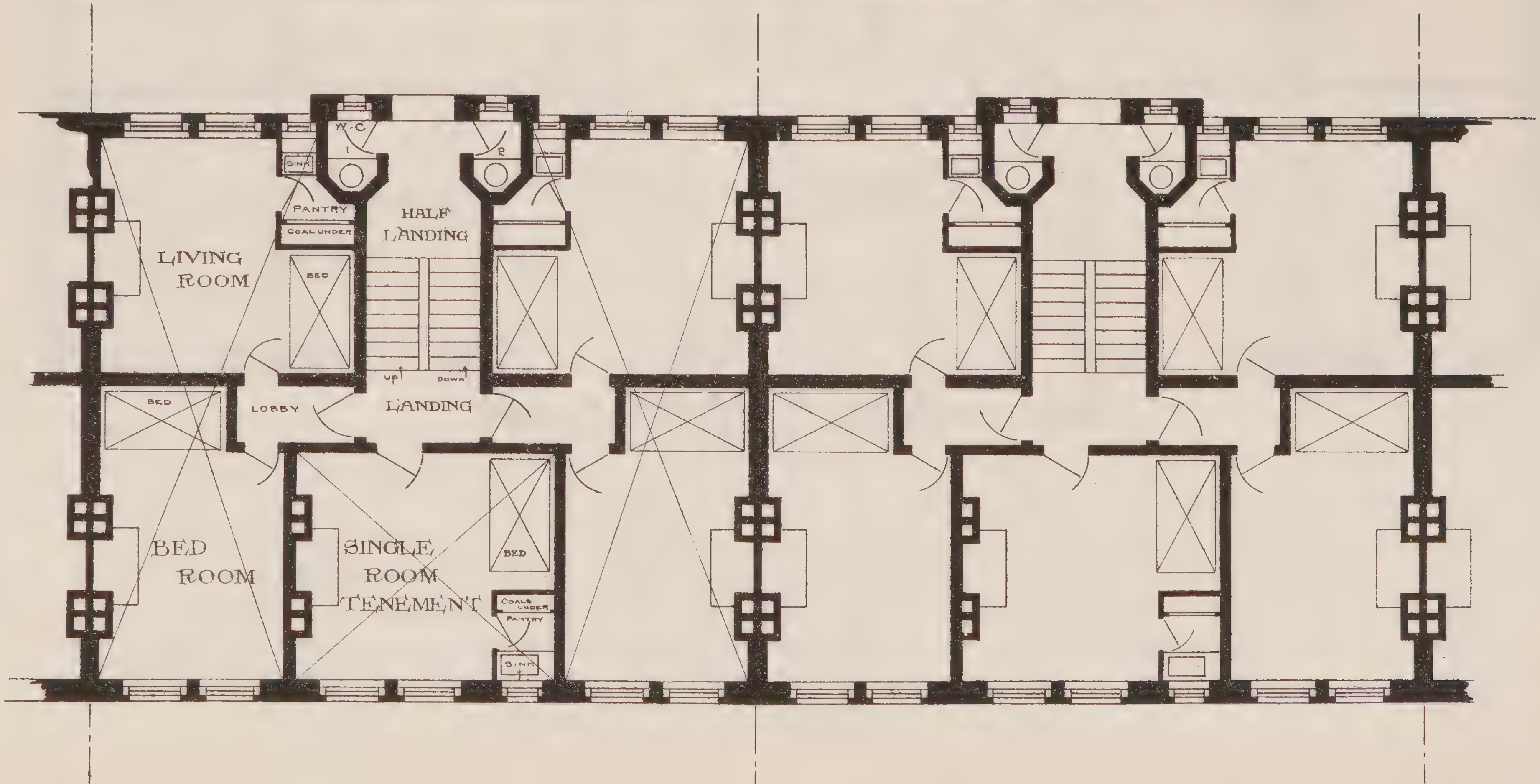
Water Tanks.

The water storage-tanks, constructed of galvanized iron, may find their place on the flat roof, and should afford a supply of about 40 gallons for each tenement. Each tank should have a brick enclosure for protection against frost, and should be so raised from the roof that it may be emptied onto the roof either for flushing the drains below or for periodical cleansing.

Stout galvanized iron hooks should be built into the chimney-stacks at proper heights for securing the clothes drying-lines.

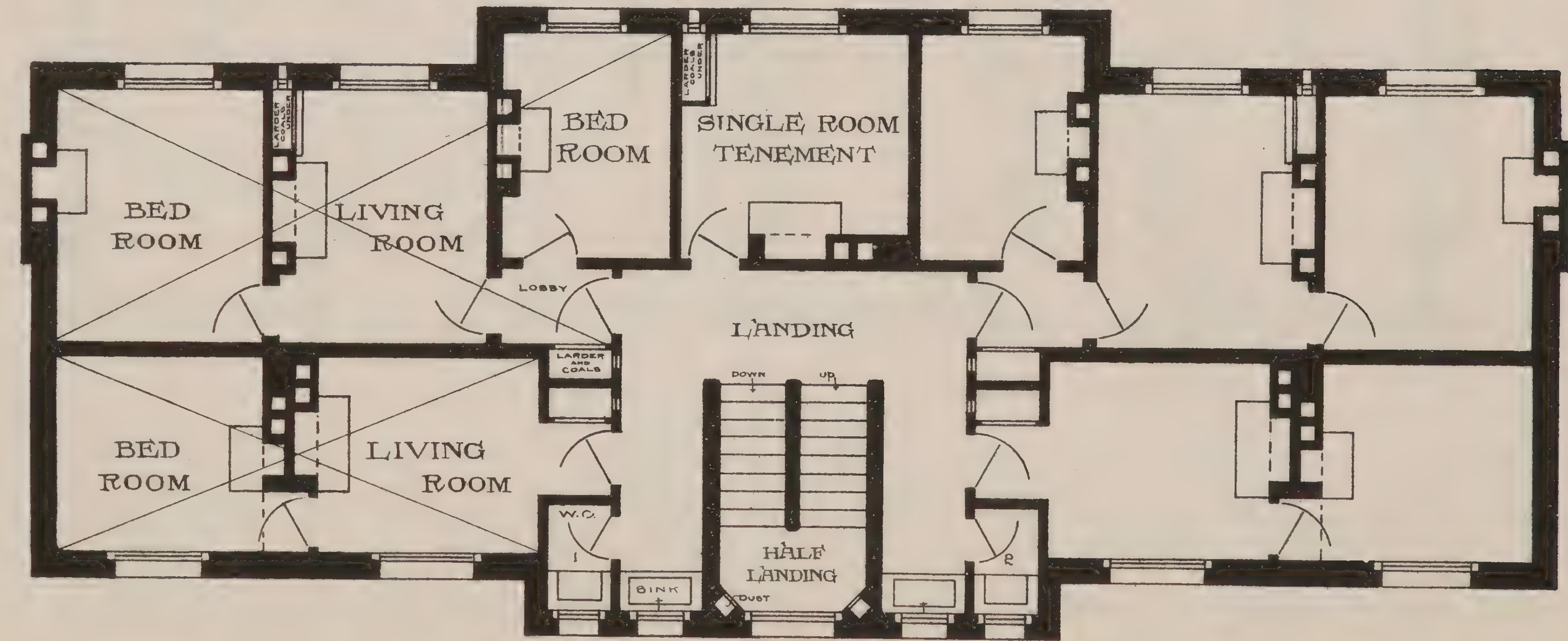
ARTISANS DWELLINGS.

PLAN No. 1 represents an arrangement of five rooms in each storey around the general staircase. The accommodation consists of two two-room tenements and one single-room tenement. Each room has a recess for bedstead and each tenement has a sink with cold water service; food, china, and coal cupboard partitioned from the room and ventilated to the outer air. Two w.c.'s are provided on the half landing of staircase for the joint use of the tenants. The arrangement affords through ventilation to the rooms and it would be advantageous to provide hinged fanlights over all the doors. A laundry and drying ground for the use of the tenants would be constructed on the flat roof.



ARTISANS DWELLINGS.

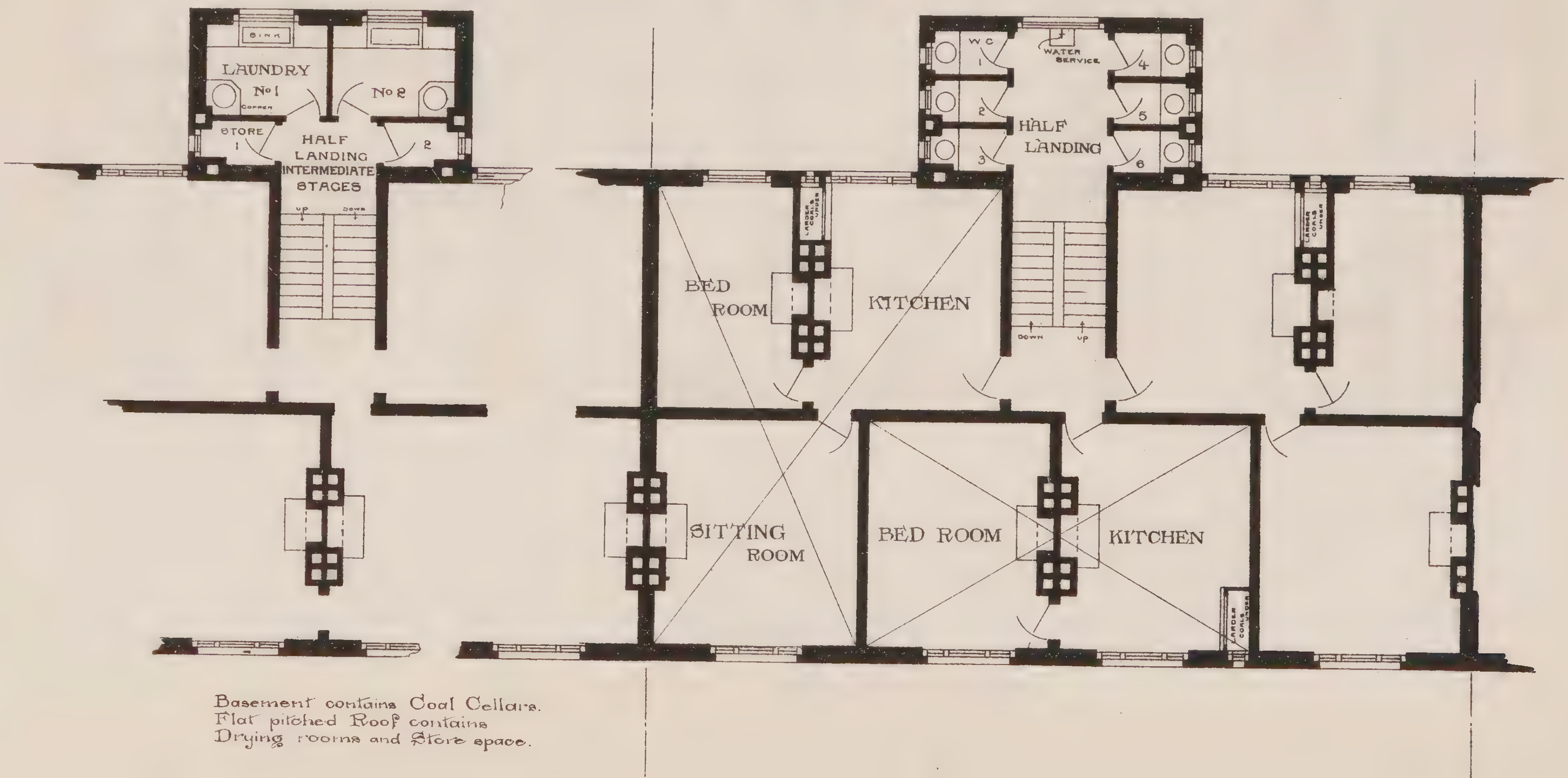
PLAN No. 2 shows an arrangement of 11 rooms on each floor around the staircase. The accommodation consists of two three-room tenements, two two-room tenements and one single-room tenement. Two enamelled stoneware sinks with cold water service and two w.c.'s are provided for the joint use of tenants. Each tenement has a ventilated food china and coal cupboard, and with the exception of the single room tenement, each has a small entrance lobby adding greatly to the comfort and privacy of the occupants. Dustshoots are formed in the angles of the staircase, the treads of the stairs are well lighted and the walls could be lined with glazed bricks. A laundry and drying-room should be constructed in the roof as in No. 1.



Laundries and Drying-room on Flat Roof

ARTISANS DWELLINGS.

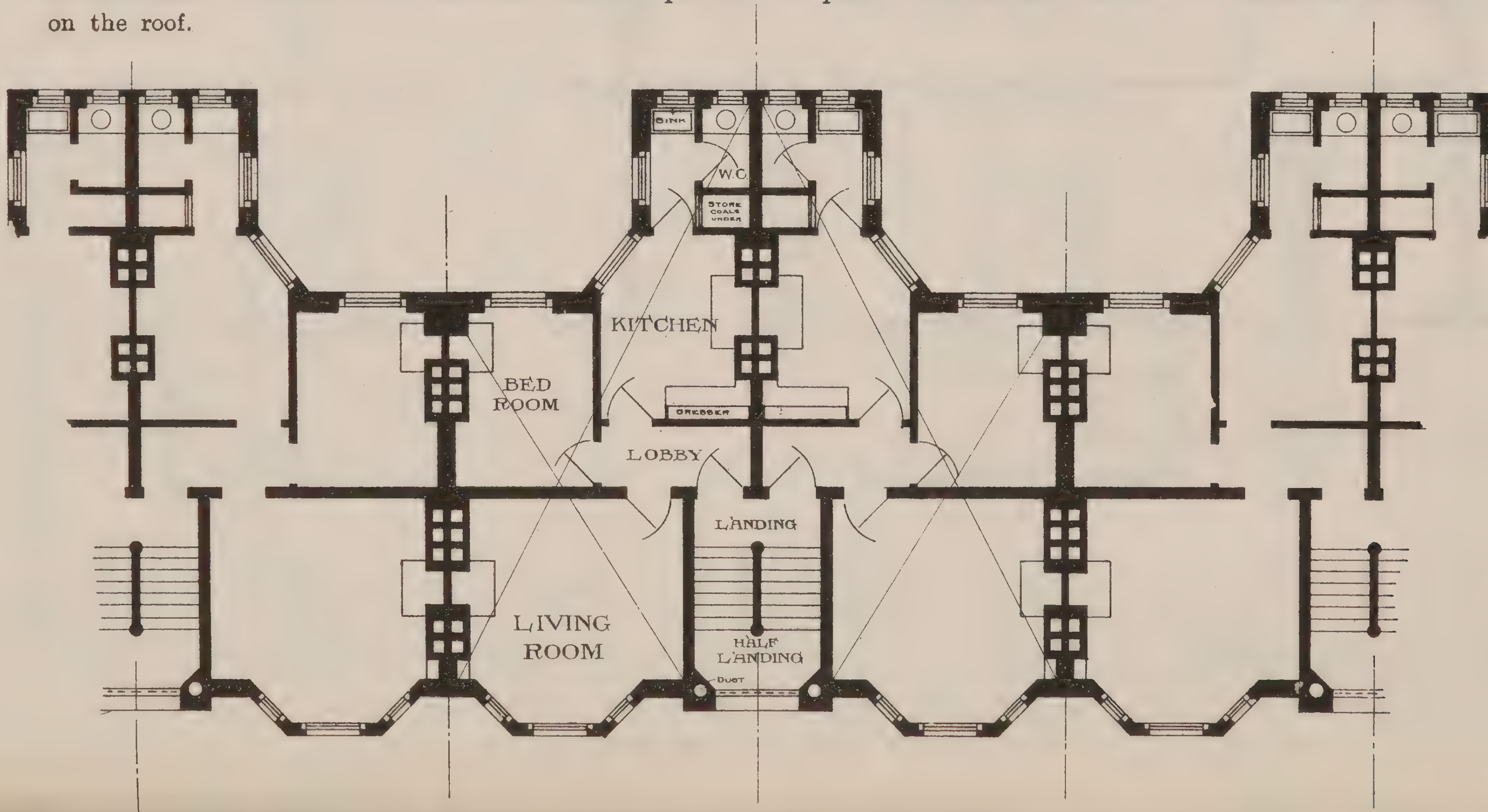
PLAN No. 3 comprises eight rooms on each storey. These may be either grouped as two three-room tenements and one of two rooms, or four two-room tenements. Each tenement has a ventilated food and coal cupboard and a private w.c. on the half-landing of the staircase where the water service is provided; and on the intermediate half-landings are provided two laundries furnished with a copper and sink in each, to be used by turn by the tenants of two stories. Drying-rooms and storage space might be afforded in a low pitched roof and cellars might be formed for the storage of coal.



Basement contains Coal Cellars.
Flat pitched Roof contains
Drying rooms and Store space.

ARTISANS DWELLINGS.

PLAN No. 4 shows a superior class of three-room dwelling. Each tenement is approached through a small entrance lobby, the living room or Parlour has a bay window adding greatly to the cheerfulness of the room, the kitchen is well lighted by a canted window, and from this room opens a well ventilated space containing food and coal store, sink and water service with a w. c. for the sole use of the tenants of this tenement, A dust-shaft is formed on the outer angle of the staircase. A wide cill to the staircase window is provided for pots of flowers and shrubs. The laundries etc. are on the roof.



General Construction.

The external walls, if not more than the height suggested, namely five storeys of 10 ft. each, will not require to be more than one and a half bricks in thickness above the first-floor level.

The bricks should be hard and square, and the mortar joints weather-pointed.

Gas-breeze and cement cast in moulds is now largely used for external lintols, sills, strings, and copings, and may be relieved with a simple incised ornament on the face.

In floor construction, some persons insist on the use of iron joists in one length between back and front walls, filled in with breeze concrete; whilst others maintain that timber with a good plaster below is sufficiently fire-resisting: the rarity of fire in such buildings being some justification for this contention. Where timber construction is used, the floors should be well pugged, to prevent the transmission of sound. Tongued and grooved floor-boards should in all cases be employed as being more easily kept clean than straight-jointed boarding-joints, which soon open and harbour dirt.

Drainage.

The drainage system should be of the simplest kind and executed with the greatest possible care.

The soil-drains in the yards, &c., should not be less than 6-inch glazed stoneware socketted pipes, jointed in cement, laid on a bed of concrete to a fall of not less than $2\frac{1}{2}$ inches to 10 feet, with ventilated inspection pits at every bend, and an intercepting chamber as close as possible to the junction with the street-sewer.

The stack-pipes should be of galvanised cast iron, with socketted and caulked joints, connected directly with the drains, and continued some 7 feet above the roof as ventilators. These may be made to serve also as rain-water pipes, by means of a species of movable ventilated bell-trap, and are available for flushing the drains when the water-tanks are emptied.

The W.C. apparatus, which may be a Bristol glazed flush-out closet with water-waste preventing cistern, should have specially cast iron Y connections with the stack-pipes that there may be no joints in the thickness of the wall. The stoneware sinks may be fitted with $1\frac{3}{4}$-inch glazed waste-pipes, with syphon traps and inspection inlets, discharging outside the building by a stack-pipe above the water line of a yard gulley-trap.

All the water-mains should be of galvanised wrought-iron pipe, and stop-cocks should be provided for shutting off the water from each separate tenement in the event of repairs being required.

Fire Hydrants.

Fire hydrants should be provided at intervals in the courtyards; they would be found useful for watering and cleansing the courtyards as well as for the extinction of fire.

Cost of Land and Buildings.

Details of cost are not easily obtainable, nor are the figures of executed schemes unfailing guides for the future.

Some undertakings owe their remunerative returns to the liberality of a ground landlord who has leased a site below its market value, as in the case on Lord Portman's estate in Lisson Grove, and on the Duke of Westminster's estate in Oxford Street. A marked contrast presents itself in the case of the Petticoat Square site, where the land cost the Commissioners of Sewers at the rate of £14 per square yard, including trade compensation to tenants for disturbance.

Mr. Moore, of the Improved Industrial Dwellings Company, calculates the average amount paid for freehold land by his company to be about 30s. per yard, the highest they have paid being £2 14s. 4½d. Mr. Moore calculates the present cost per room to be about £60, including W.C.'s, laundries, &c., the average weekly rent per room being now 2s. 1¼d.

Tenant Proprietorship.

In view of the increasing political power and wage-earning capacity of the working classes, I venture to urge consideration of the question of tenant proprietorship. I believe myself right in saying that facilities for purchase have largely been taken advantage of by artisans in many towns in the North of England, where the encouragement of thrift, sobriety, and self-respect has been eminently beneficial to the tenants.

So important is this matter considered in France, that the "National Association for the study of questions relating to the improvement and construction of cheap dwellings," which is an outcome of the International Congress held in Paris during the Exhibition of last year, has devoted the whole of its first publication to details of a scheme adopted in Havre for giving facilities to artisans for the purchase of four-roomed cottages in their own walled gardens, by quarterly payments extending over 14 years, and amounting to 10 per cent. on the purchase money paid annually.

The chief distinguishing feature consists in the fact that when one-third the purchase money has been deposited, a conditional deed of conveyance is granted, which is saleable, and

this constitutes a marked departure from the lines of most of the Building Societies in our own country.

In London an association has recently been established under the auspices of the officers of the Leman Street Co-operative Wholesale Society, from the prospectus of which I quote the following :—

"The Society was formed in 1888 with the object of applying to the owning and letting of working men's dwellings the principle of co-operation, which has proved so successful when applied to retail distribution.

"Fair rents, according to the current rates of the locality, are charged to the tenants, who must be members of the Society. After making proper provision for expenses, &c., a dividend, limited to 4 per cent., is paid on the share capital, and the remainder of the profits are divided amongst the tenants in proportion to the rents paid by them, and when so divided are carried to the credit of each tenant's share account until he has so much capital in the Society as is equivalent to the value of the building inhabited by him. After such a period has been reached, the dwelling occupied by the tenant will remain the property of the Society, but he will be entitled to receive his share of surplus profit in cash.

"When a shareholder ceases to be a tenant, the Society will have the right at any time to purchase and extinguish his shares; but in the event of the Society being unwilling to exercise this right, the shareholder will have the usual power of selling them."

The rules provide that internal repairs shall be done when the Society deems necessary, and, unless carried out by the tenant of the repaired building, they will be charged against his share account.

Each estate is to be managed by a committee of tenants, and it will be to the interest of every member of the Society to find a tenant for an empty dwelling, as well as to see that his fellow members are careful with the Society's property and pay their rent punctually.

The advantages offered are, a share in the increased value of the real property of the Metropolis caused by the growth of population; an attractive and profitable mode of investing savings, an economy of rent, and the prospect of becoming capitalists.

It is too soon yet to judge of the success of the scheme, but the Society has already two small properties in full occupation, the one at Upton Park, the other at Penge. Am I unreasonable in suggesting the possibility of a scheme for appropriating to the erection of dwellings, in the form of loans,

some part of the rapidly-increasing resources of the Post Office Savings Bank, by affording facilities to depositors to convert their savings into shares, and thus extending the interest of artisans in a commercial enterprise of the greatest social value?

Summary.

I have to express my thanks for your indulgent attention, and in conclusion, would summarise my observations as follows:—

1. That artisans' tenement dwellings need most careful planning and construction, to secure the healthfulness and moral welfare of the tenants.

2. That, in the interests of the artisan class, and for the relief of the congestion of our central districts, increased facilities should be afforded for residence in the outskirts by reorganised train-services at low fares.

3. That tenant proprietorship, which has elsewhere proved a boon to artisans, should be encouraged by all equitable means in the neighbourhood of London.

These remarks I commend to the earnest consideration of all those who have at heart the health and welfare of our artisans and labourers and their families, and especially to the members of The Sanitary Institute.

Mr. E. C. Robins (London) observed that the plans prepared by Mr. Hooper showed great improvements in modern industrial dwellings. One thing especially was important, and that was the private manner in which the buildings ought to be constructed. He objected to their looking like workhouses or warehouses, and pointed out that many people did not like to be associated with anything that looked like charity. In the dwellings over which he had some supervision he found there was a demand for separate water-closets, but this was an expensive arrangement, and perhaps the best thing to do was to give these closets a separate access. In cases where the houses had flat roofs some were used for the purpose of washing clothes, whilst others became drying-grounds, and some play-grounds. But they found that the inmates did not care about the wash-house being thus situated though they did not at all mind the roof being used as a drying-ground.

Mr. H. H. Collins (London) said with regard to a point raised by Mr. Robins that he thought, do what they would, this question of industrial dwellings must become one of charity. They could not then look like palaces, and if people wanted cheapness they must be content with a very small return for their outlay. The first question was that

of land. Artisans wanted to live in good neighbourhoods but did not care to pay the additional cost, forgetful or ignorant of the fact that when owners had to pay more than twopence per foot for land, it was impossible to secure the accommodation they wanted for two shillings a room. He disapproved of sculleries, closets, or corridors being in common. He found it cost him no less than £50 for each room of measurements something like $12 \times 14 \times 10$. However, instead of the artisan using them he found they became occupied by clerks and their families, so that their end was very different from what was intended. Then the rooms had to be of sufficient height—8 feet had been mentioned as the minimum—and he held in addition they should be fire-proof.

Dr. SYKES (London) spoke from his experience as a member of the Council of the National Dwellings Society, and held that the last block of artisans' dwellings that had been erected, that in Waterloo Square, Camberwell, was the very finest. The question was largely one of cost, and he thought instead of calling them artisans' dwellings, they would be more accurately described as dwellings at 2s. 6d. per week, or block dwellings, so as to distinguish them from ordinary private houses. Recently he had had occasion to enter into some research, concerning the number of persons that could be housed on a given space. Much depended of course on the conditions, one of the first of which was the width of the front and back space. The angle of incidence of light should be at least 45 deg. One of the chief things to be considered was economising space. In the Peabody system they got about four-fifths of their properties for dwelling purposes and the other fifth for access and accessories. With regard to sleeping and living-rooms, the usual amount of space was 300 feet per person for living-rooms, and 400 for sleeping and living when combined. This, he considered was not sufficient. Instead of 300 or 400 it ought to be 700 feet for each person. Whilst he recognised the necessity of providing wash-houses, coppers, coal-sheds and sinks, he thought that baths in industrial dwellings were a great mistake. He had found that the baths became blocked up with various items of furniture and were never used. The people did not like them, and he snpposed a reason might be found in the fact that there was no hot water. If baths were to be adopted at all, he suggested that they should be erected in separate buildings fitted with hot-water pipes, and be placed under the charge of an attendant. He objected to any artificial systems of drainage or ventilation, for the people did not understand any but the simplest constructions and all others became speedily out of order. As to the question of charity, he did not know of any rooms that could be let for one shilling or one shilling and sixpence per week. The least he thought they could let single rooms for was two shillings and sixpence per week. In common lodging houses in London, the lowest charge was fourpence per night or two shillings and fourpence per week, and yet the County Council were thinking of exercising their charity (in spite of the Industrial Dwellings which were let, as he had shown, cheaper) by erecting a

number of these houses. In his experience Industrial Dwellings could not be erected under £56 a room, and it was absurd therefore to think of letting them under two shillings and sixpence a week. With regard to the question of common closets, common corridors, and common things generally, these were the amenities of social communities living together, and the improvement that was wanted must come he thought from the manners of the people themselves.

Mr. William White (London) had been asked to suggest that there should be a mortuary attached to Industrial Dwellings, and also that it would be a great advantage if provision could be made for gas stoves. With regard to ventilation he thought a flue should be constructed with openings near the ceiling, so as to ensure the circulation of air.

Mr. Hooper (London), in reply, said that he had alluded in his paper to the dwellings in Glasgow, where provision was made for single room tenants. Recesses were made for the bed, the room was well ventilated, and it had a closet with sink and fuel stove and cooking implements.

The President of the Section pointed out, that if they made Industrial Buildings so perfect as to render them expensive, many artisans would prefer the cheaper dwellings that were already in existence.

SECTION III.

CHEMISTRY, METEOROLOGY, AND GEOLOGY.

ADDRESS

By W. TOPLEY, F.R.S., F.G.S., Assoc.M.Inst.C.E.,
Geological Survey of England.

President of the Section.

"*Geology in its relation to Hygiene.*" *

It is possible that the remarks which I wish to make in opening this Section may be considered by some to be rather out of place at a meeting of this Institute; some may think them too special and technical; but the subjects admitted to Section III. are so extensive that specialisation on the part of its President is to some extent a necessity, and I think further that a man is best occupied when speaking on a subject which he knows fairly well.

It may be that by taking a special district as our text we can well illustrate some general principles; and at the same time a description of the district in which we are now meeting may not be without interest to some now visiting it.

The geology and scenery of Sussex may be considered somewhat tame and uninteresting to those who arrive here from the wilder and more mountainous districts of the North and West; yet for many reasons Sussex is peculiarly well suited for illustrating the subject before us. The varieties of soil are here strongly marked—clay, sand, and limestone being each well developed. The conditions under which springs and under-

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* The various points referred to in this Address were illustrated by numerous Diagrams, including the Maps, Sections, &c., published by the Geological Survey. Information relating to the geological structure of the district will be found in the author's "Geology of the Weald" (*Memoirs of the Geological Survey*), 1875. Reference may also be made to a paper on the "Agricultural Geology of the Weald," in "Journ. R. Agric. Soc.," Ser. 2, vol. viii., p. 241, 1872.

ground water occur, and the quality of the water obtained, vary greatly in different parts of the county, and this variation of condition almost entirely depends upon geological structure.

Speaking broadly, we may say that Sussex is divided into seven nearly parallel east and west bands, each well marked off from the next by different geological characters. If we take these in order, going from south to north, we name them in the order of their geological age, the newest coming first :—

	Nature of the Soil.
1. Drift and Tertiary Beds of the Coast, from Brighton westwards	Various.
2. Chalk	Calcareous.
3. Upper Greensand	Calcareous and sandy.
4. Gault	Clayey.
5. Lower Greensand	Mostly sandy.
6. Weald Clay	Clayey.
7. Hastings Beds	Various.

Partially covering up these strata in places there are small areas of old River Drift (gravels and loams); there are also the alluvial flats along the rivers, but none of these are of much importance in relation to the subjects to be now discussed. The Alluvium, &c., of Pevensey Level covers a large area, but this district contains only a small population.

The central parts of the Weald, forming the north and north-eastern parts of Sussex, are thus formed of the oldest beds. The strata dip generally to the south, and therefore newer beds come on as we pass from north to south. This statement, however, is true in a wide and general sense only, especially for the Hastings Beds area. There are numerous variations from this rule due to rolls of the strata, forming what are known as anticlinal and synclinal folds, which, together with the faults (or actual breaks in the continuity of the strata), have an important bearing on the physical geography of the country, and also on the course of the underground water.

Perhaps the hygienic aspects of geology could be best discussed by grouping our remarks under three main heads :—

Distribution of the population.
Water-supply.
Distribution of disease.

So far, however, as surface water-supply is concerned the first and second necessarily go more or less together, as the primitive settlements of the country were almost invariably dependent upon the occurrence of springs (or of water at shallow depth) and dryness of soil. Water-supply in its modern sense, as dependent upon deep wells, involves geological ques-

tions of a more intricate nature, and many places in the Weald of Sussex, admirably situated for once obtaining a good surface supply for a small population, are badly situated for obtaining a large supply from deep wells. The population of many villages is not increasing: even for those which have to some extent increased, the natural water-supply from springs, streams, and shallow wells would still suffice. But cesspools have hopelessly poisoned the wells and springs, and systematic sewerage has fouled the streams. No one well acquainted with the condition of rural England can doubt that a large part of the sanitary work of the present day is merely combating the evil effects of ill-considered sanitary measures in the past.

In the area occupied by the Hastings Beds we find extremes of wet and dry soils. In the great majority of cases the villages stand upon sandy sites, but often near the outcrop of a clay-bed, which throws out water at its junction with the sand above, or which holds up water in shallow wells.

The most important exception to this rule, of sandy sites in the Hastings Beds area, is the town of Battle, which owes its site to the great battle of Hastings. The English and Norman armies encamped on opposite heights : but the battle was mainly fought on the clayey flats and slopes between these heights; here the body of Harold was found, and here the Abbey was built, near which the town subsequently grew.

When places stand upon Tunbridge Wells Sands, and require more water or better water than the surface-wells yield, it is generally necessary to sink through the Wadhurst Clay into the Ashdown Sands. When the outcrop of the Ashdown Sands is near this method is generally successful, but when the outcrop of the Sands is far off such wells occasionally fail. A noteworthy instance occurred at the Cuckfield Workhouse, where a boring was carried 119 feet through the Tunbridge Wells Sands, then 227 feet through Wadhurst Clay, and 104 feet into Ashdown Sand, making 450 feet in all, without obtaining any supply.

It rarely happens that very deep wells are successful in the Weald, the reason being that water in deep wells has generally a long distance to travel underground from the outcrop of the water-bearing stratum to the well. In very porous strata (as the New Red Sandstone and much of the Lower Greensand) or in strata containing numerous fissures and divisional planes (as the chalk), this distance from the outcrop is not necessarily a serious obstacle ; but in such fine-grained rock as those composing the Wealden Beds the case is different.

The strata, besides, are divided by numerous bands of clay, and are often traversed by faults, so that underground water

does not travel far along the lines of stratification. Faults, however, often acts as conduits, and thus aid the passage of underground water.

Hastings affords an excellent example of the difficulties which beset a town situated on the Wealden Beds, and also of good fortune in seeking for waters in those beds.

The older wells are sunk in a valley just north of the town. It seems to have been by accident that this place was chosen, but it is an exceptionally good one. A fault, apparently, has some effect in concentrating the water here; and it is remarkable that several wells should be sunk in so small a distance, all yielding water, and no one apparently affecting any other. The wells sunk at Filsham for the town of Hastings, and at Silver Hill for the Rural Sanitary Authority are near faults, and this may account for the good supplies of water there obtained.

Deep borings had been tried at and near Hastings, but with small success; the lower beds (Fairlight Clays) are alternations of clay and sandstones, and in no case have they yielded much water, except sometimes in their upper layers. Deep borings have been carried into these beds at Rye, and at Lydd on Romney Marsh, but both failed.

Beneath the true Wealden strata there are some important beds of limestone (with shale and sandstone), which were formerly much worked near Brightling and north-west of Battle; these are now known as the Purbeck Beds. It is possible that some water may be obtained from these beds near their outcrop, which, however, is not extensive; but such water would be exceedingly hard.

The sub-wealden boring traversed a great thickness of strata (1,700 feet) below the Purbeck Beds, and found no water in any of them. Deep borings in the Weald must therefore no longer be looked to as sources of supply.

I have spoken of the assistance which faults sometimes give to the passage of underground water, and of the desirability of studying them when seeking for a supply. But one other point should also be borne in mind, and that is to sink if possible where the strata form a basin and not where they form an arch. In the former case the water drains towards the well, in the latter case the water tends to drain away, and even if found in sufficient quantity would not rise in the well. An underground basin does not necessarily coincide with a surface depression; often it forms a hill, so that a low-lying site is not necessarily a good one.

The water from the Wealden strata is generally of a low degree of temporary hardness; but it always contains sulphate

of lime, and then has some permanent hardness, but as a rule this is not excessive. A more frequent trouble is the ferruginous nature of the water. The iron is not often in sufficient quantity absolutely to prevent the use of the water for domestic purposes, but it is certainly objectionable—it stains the linen and blackens the tea. Of important wells thus affected, those at Bexhill and at the Hayward's Heath Asylum may be mentioned, but the trouble is largely lessened by simply aerating the water.

The ferruginous water of Tunbridge Wells rises from the Tunbridge Wells Sand, the highest division of the Hastings Beds. This is the only mineral spring in Sussex which has retained its reputation, and this is probably due more to the beauty of the country than to the virtue of the waters. At the time when Tunbridge Wells water was most in favour, some other ferruginous springs came into note. St. Ann's Well, at Furze Hill, near Brighton, is a case in point, although this rises from the Tertiary Beds overlying the Chalk. Adam's Well, at Speldhurst, a little N.W. of Tunbridge Wells, was also a ferruginous spring of some celebrity, but its reputation only survived in curing mangy dogs.

Geological maps show a wide stretch of Weald Clay between the Hastings Beds on the north and the Lower Greensand on the south; but in this there are thin subordinate beds of sand, on the outcroppings of which many villages and farms are built. These sand-beds give rise to small springs, and yield small supplies of water to wells. There are also some thin beds of hard limestone (Sussex marble) in the clay, which often yield water in wells; but this water is rarely of good quality.

A more important bed near the bottom of the Weald Clay is the Horsham Stone and the sandy beds associated with it. This makes some light land of much better quality than the rest of the Weald Clay area. A great part of the Aylesbury Dairy Farm, at Stammerham, lies on the Horsham Stone. The springs on the farm are mostly out of the sand-beds; the wells are sunk into the clay and shale which come between the Horsham Stone and the Hastings Beds; water from the latter bursts up through the shale, and rises in the wells.

The Lower Greensand occupies a considerable area in Sussex, and some important towns stand on it; amongst these Pulborough, Midhurst, and Petworth. As a whole it is sandy, making a dry and porous soil; but there is a middle division (Sandgate Beds) in it consisting of a varying series of beds—clays, ironstone, and sand. The water from the middle division is often impure, but good water can generally be obtained by sinking to the lower division, the Hythe Beds. Petersfield,

which lies just west of the county boundary, has recently been supplied in this way. The water so obtained in Sussex is generally much softer than Chalk water; whilst water obtained from the Hythe Beds of Kent is hard, in consequence of the large amount of limestone which there occurs.

The Lower Greensand has been looked to as a source of water supply from beneath the Chalk. The numerous instances in which attempts have been made to obtain such water under London are well known, as unfortunately is also the failure which has attended these attempts. A deep well sunk many years ago at Warren Farm, Brighton, was more successful, but the quantity of water so obtained was not large.

A deep well was sunk many years ago at Chichester, but this only reached the Gault.

The Gault forms a band of clay land between the Upper and Lower Greensands. It is mostly in pasture, and has a very small population. Only one village in Sussex (Heyshot) stands on Gault; whilst one (Hardham) is on Gault covered by gravel.

Water on the Gault can only be obtained by sinking down to the Lower Greensand. This rarely fails to obtain a good supply of soft water, but a boring recently made at Firle has been less successful. The Lower Greensand is there very thin, and the sand is rather clayey, and the boring passes through this and into the Weald Clay without obtaining a supply of water.*

The Upper Greensand forms a narrow band, cropping out under the South Downs. It is remarkable for the number of villages which stand upon it; the original settlements having been determined by a very fertile and comparatively dry soil, and by an abundance of water. Very powerful springs break out along the Upper Greensand terrace, sometimes at the base of the Upper Greensand, but sometimes a little above it, from the lower beds of the Chalk. Mr. Clement Reid, who is now re-examining the country for the Geological Survey, is of opinion that many of the supposed Upper Greensand springs come from the Chalk, the Chalk water finding its way down through fissures into the Upper Greensand. The outcrop of this formation is too narrow to account for all the water which it yields.

I may here incidentally allude to a question of much interest, in which geological structure has had a striking influence, not only on the original settlements of the country, but also on the land-divisions which are now known as parishes.

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* My colleague, Mr. C. Reid, informs me that, since this Address was delivered, the tubes have been partially withdrawn and another attempt made to pump water from the thin bed of Lower Greensand, this time with more success.

The villages at the foot of the Downs, which generally stand on the Upper Greensand, belong to parishes which extend up the Downs to the South, and also extend over the Gault and more or less over the Lower Greensand area to the North. Where the Lower Greensand area is narrow, the parishes extend down the steep slope or escarpment of the Lower Greensand into the Weald; but where the Lower Greensand is wide, there are other villages whose parishes are wholly on that formation.

Near the edge of the Lower Greensand there are other villages, but the parishes belonging to these extend down the escarpment of the Lower Greensand into the Weald. The escarpment of the Chalk and of the Lower Greensand thus have quite opposite characters as regards the parishes in which they are contained. The Chalk escarpment belongs to villages lying below (or to the north of) it; the Lower Greensand escarpment belongs to villages lying above (or to the south of) it.

The Chalk escarpment around the Weald is divided into 125 parishes, 119 of which belong to the villages situated below the escarpment. Of the six exceptions to the rule only one (Piecombe) occurs in Sussex. The exceptions to the rule as to the Lower Greensand escarpment around the Weald are more numerous—15 out of a total of 103. From these and from many other facts, which it would be out of place here to discuss, it is inferred that the oldest settlements in the S.E. of England were beneath the Downs, along the coast, and in the wider valleys between the coast and the Downs.*

Brighton and the Sussex towns to the west of it give interesting examples of excellent water supply from shallow wells on the old plan of water supply, and also from deeper wells on the new plan.

The superficial deposits which occupy the plain between the Downs and the sea from Brighton westwards, yield water in shallow wells; but this is insufficient for a general supply, and moreover is now generally fouled where population is thick. But beneath these superficial deposits and the Tertiary Beds which underlie them, there is the Chalk, a great reservoir of underground water. No town in England has taken fuller advantage than Brighton of geological conditions as affecting its water supply. The system adopted has been fully discussed by

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* I have discussed this question more fully in a paper read before the British Association at Brighton in 1872, and subsequently published in the Journal of the Anthropological Institute, Vol. iii., p. 32, 1873; also in the Geology of the Weald (Memoirs of the Geological Survey, p. 396, 1875). Mr. F. E. Sawyer has also investigated the early settlements of the country in a paper published in the Archæological Journal, Vol. xli., page 35, 1884.

Mr. E. Easton on previous occasions, and by Mr. Alderman Hallett at this meeting. Water is constantly flowing through the Chalk along numerous lines of fissure, large and small, and in part along the lines of flint. This water finds its way out to sea in great quantities at and near low-water mark. During the construction of the Brighton Intercepting Sewer, 15,000,000 gallons of water were pumped every twenty-four hours. Often marine vegetation cannot grow because of the amount of fresh water coming out of the Chalk, and farmers frequently take their cattle to the shore in the time of drought.

The object of waterworks is to intercept some of this water, and this is best done by sinking wells to about low-water mark and then driving galleries to intercept the lines of fissure. The flow of underground water in the Chalk has been well studied by Mr. Baldwin Latham, near Croydon, and he has shown that its flow can be mapped out into a system of underground lines which do not always coincide with surface-valleys. Sometimes, indeed, the underground flow passes under a surface-hill from one valley to another. This, perhaps, will be found to be the case with the southern Chalk area when its water system is more fully mapped out. There seems, however, to be an important underground flow at Goldstone Bottom, which has made a curious surface-depression, the bottom of which is some 30 feet below the lowest point of the surrounding rim; this is probably due to the dissolving action of the underground water.*

At the Newhaven Water Works (East Blatchington) a well is sunk, 179 feet, to Ordnance Datum; galleries are driven in four directions which find some water in a bed of flints; there is also a bore hole 145 feet below one of the galleries which yields water. Worthing, Littlehampton, and Bognor all obtain their water from wells sunk into the Chalk, supplemented by bore-holes below sea-level.

Some interest attaches to the water supply of the shingle flats of Langley Point and Dungeness, for wells are sunk into the shingle within fifty yards of the shore, and obtain a fair supply of fresh water. This water rises and falls with the tide, and in very dry weather it may sometimes be slightly brackish. The rain falling on the shingle immediately runs through it, and is held up by the silty alluvium beneath. In Selsea Peninsula water is also obtained from shingle underlying brick earth and loam; but this is from an older shingle lying above the level of the modern beaches.

* W. Whitaker, On the Waterworks at Goldstone Bottom, Brighton. Geological Magazine, 1886, p. 159.

Distribution of Diseases.—Dr. Buchanan's researches into the geological distribution of consumption in the south-east of England must be well known to all present; it is therefore unnecessary to devote much attention to this most interesting question. He found that the great predisposing cause was dampness of soil, and that consumption prevailed in any district in proportion to the amount of damp and clayey soil which there existed.* This was the only conclusion which fitted in with the facts, and with few exceptions it fitted remarkably well. But there were some districts to which the general conclusions seemed to apply with less directness than elsewhere, and amongst these somewhat anomalous areas were some of the West Sussex districts.

An enquiry such as that undertaken by Dr. Buchanan can only be founded on published statistics relating to registration districts and sub-districts; but as these generally include great varieties of soil and feature, the investigation is beset with difficulties. Medical officers of large districts have excellent opportunities of studying this question, as all requisite details are at their command.

Dr. C. Kelly, the medical officer for West Sussex, has fortunately greatly interested himself in questions of this nature, and a large amount of important information upon the geographical and geological distribution of disease is to be found in his annual reports. Dr. Kelly states that in West Sussex dampness of soil does not alone explain the prevalence of consumption in certain districts; but that, if to dampness of soil we add exposure and bleakness of situation, there is a more general agreement.

Dr. Kelly finds that in West Sussex the mortality from phthisis and from all causes is very nearly the same in each variety of soil, but that the mortality from diphtheria and from lung disease varies considerably, being much higher in wet and retentive soils than in dry and pervious soils.

The decreasing death-rate from consumption is an important fact. In a very small degree this is perhaps due to a more correct terminology of disease; but as the death-rate from lung disease shows only a slight increase, this can only account for a very small part of the improved consumption rate. It is pro-

* "On the Distribution of Phthisis as affected by Dampness of Soil," Appendix 5, to 10th Report Medical Officer of the Privy Council (for 1867). The geological information for this report was supplied by the Geological Survey. The special geological points involved in the inquiry were also discussed by Mr. W. Whitaker, in a paper "On the Connection of the Geological Structure and the Physical Features of the South-East of England with the Consumptive Death-rate," "Geol. Magazine," 1869, p, 500.

bably in part due to improved drainage and to the removal of subsoil water from near the houses; but agricultural drainage generally must also be credited with a large part of this improvement. Boggy area is drained; the water is carried off the surface of the land more quickly than in former times, and the air is therefore less damp.

Dr. Kelly brings out most clearly the prevalence of Diphtheria upon damp soils, especially upon the Weald Clay. An intensifying cause may be found in the fact that the population is sparse and scattered; the children having long distances to go to school, over roads which are very wet and muddy in wet weather.

Much has been written upon the distribution of Goitre, and most writers endeavour to show some striking relation between its distribution and certain geological conditions in districts where it prevails. Many of the results are curiously contradictory. The favourite idea formerly was that it prevailed in limestone districts; if so, surely all chalk areas ought to be subjected to it, and also all towns deriving their water supply from chalk wells. Another suggestion, equally groundless, is that goitre is due to water containing magnesian carbonate. There is more to be said for the view that goitre prevails where limestone rocks are more or less impregnated with metallic sulphides, especially iron and copper sulphides; although it is very doubtful if even this explains all the facts.

McLelland showed in 1861 that limestone areas containing metallic ores, &c., are liable to goitre; and St. Lager* discussed the matter more fully in 1867, showing that the presence of iron sulphides in any rock or soil was a predisposing cause. Prof. G. A. Lebour† has more recently discussed the geological distribution of goitre, and has adopted Dr. St. Lager's conclusions.

There is no doubt, however, that much more information than we at present possess must be collected before any safe conclusions can be drawn as to the influence of geological conditions (if any) upon the distribution of goitre. Certainly if ferruginous water be a predisposing cause, goitre ought to be very generally distributed through the Weald. Fortunately we have in Sussex an opportunity of fairly testing this theory. The water-supply for the County Lunatic Asylum at Hayward's Heath has been a constant source of trouble in consequence of

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* "Études sur les Causes du Cretinism et du Goître endémique." Paris, 1867. (Noticed in Med. and Chir. Rev., July, 1868.)

† On the geological distribution of Endemic Goitre in England. Newcastle Meeting of Medical Associatian, 1881.

its ferruginous character. The water comes from a well boring 210 feet deep; at seventy-one feet from the surface there is a band of iron pyrites, which is probably the main source of the iron. Of late years this iron has been largely removed by aeration, but there is still some in the water.

If constantly drinking ferruginous water derived from sulphides is a cause of goitre, we ought to expect some development of the disease in the case of those who have been long in the Asylum. Dr. Saunders informs me that of the 820 patients now there, 283 have been there for ten years and more, whilst 100 have been there over twenty years. There are amongst the 820 patients six cases of well marked goitre, and five more of slight thyroid enlargements; but in all these cases the symptoms were present before admission.

It is much to be desired that this question could be exhaustively studied. It can only be done by medical men in actual practice, or at any rate it is they who must supply the data. The Wealden district is a very favourable field for this investigation, and I would venture to commend it to the notice of the profession in Sussex, as one that might well be worked up for the International Congress of Hygiene which is to meet next year in London. I shall be very glad to render such assistance as is in my power in supplying the geological information required.

Mr. Woodruff (Brighton) moved a vote of thanks to Mr. Topley for his valuable paper. The geological formation of Sussex was always interesting, and Mr. Topley had increased it by presenting it in a fresh manner. Sources of water supply, the distribution of disease, indeed all the points raised by him might be studied with great advantage.

Dr. Tatham (Manchester) formally seconded.

Sir Thomas Crawford (London), in putting the vote of thanks to the Section, pointed out the importance of studying these geological questions from a Sanitary point of view.

The vote of thanks was unanimously carried.

On "The Climate of Brighton," by FREDERICK ERNEST SAWYER, F.S.A.

FOR about a century and a half Brighton, ever increasing, has flourished as a "health resort," and it is therefore important, in considering the various branches of its *Sanitary* history, not to omit reference to its Climate, to which, coupled with Sea-Bathing, its proud position as "the Queen of Watering-places" is due. Emperors, Kings, and Princes, too numerous to mention, have enjoyed the benefits of its pure air; whilst poets, novelists, and authors, have spread its praises abroad.

Sydney Smith observed that "Brighton was a place of which all rich and rational people in the metropolis should take small doses from time to time." Thackeray (a constant visitor) had doubtless heard of this dictum, which he expands in *The Newcomes* into the oft-quoted passage—"It is the fashion to run down George IV.; but what myriads of Londoners ought to thank him for inventing Brighton! One of the best physicians our city has ever known is kind, cheerful, merry Doctor Brighton;" whilst Mr. G. A. Sala, who may almost be claimed as a native, says—"From my fidelity to Brighton I will never swerve; it is to me the place *par excellence* in which to get well and keep well; but after Brighton give me Ajaccio."

Much has been written about the climate of Brighton, and medical works containing few (if any) meteorological statistics, have produced many rash assertions on the subject. One of the most peculiar is that of Dr. A. L. Wigan, entitled "Brighton and its Three Climates," nearly a third of which is devoted to a treatise on the necessity of paying a doctor his proper fees, and obeying his orders. His statements respecting the climate are unsupported by any meteorological tables, and some are gross exaggerations, such as, "You pass from a calm air [under the cliff] at 55 or 60 degrees, to a keen wind at 35 or 40, which from its rapidity, produces the effect of a frost." Such extraordinary differences in temperature have never been recorded by any observer. The fact is Dr. Wigan, as many persons do, confused temperature with wind and humidity. Air in motion produces evaporation from the surface of the skin, and consequently an apparent sensation of cold, when there may be no actual difference in the temperature from that on a calm day or

in a more sheltered spot. The "Three Climates" may therefore be relegated to the limbo of myth, and we can commence our subject by a consideration of the physical geography of the town.

Physical Geography.

The chief feature in the formation of the Downs on which Brighton is built, is the central Y shaped valley which separates the meteorological districts of the town. At the junction of the arms of the Y valley, rises up gradually Hollingbury Hill, which is 500 feet above sea level, whilst the road round St. Peter's Church is only 48 feet above the sea. On the east of the valley the Downs rise suddenly, reaching at the Workhouse a height of 300 feet sloping off rapidly to 80 feet on the Marine Parade, and affording to the houses on the Eastern cliff almost complete shelter from the north and north east winds. On the west of the valley the hills are not so high, but reach, in Clifton Terrace and Buckingham Place, 200 feet in height; from these spots the ground gradually slopes off to the west, forming a large and moderately fertile plain, which continues through Shoreham, Worthing, and Chichester on to Portsmouth. Over this plain the mists and rain clouds pass, and meeting the long line of watershed formed by the Downs, deposit their moisture in the Weald of Sussex, and greatly increase its fertility, which enriched with the rain, and protected from storms by the Downs, is thus able to produce large forests of trees which do not grow on the more exposed hills round Brighton.

Of the two arms of the Y valley, the western one spreads out through Preston and Patcham, and ends in the Downs at Clayton, whilst the eastern one goes through Falmer to Lewes, opening out into the Weald, and is from its course the path of the south-west gales and storms of rain. It is a source of surprise to some visitors to the town that there is no river or stream running down the central valley, and that there is none within at least five miles of the town; but this is occasioned by the porous character of the chalk, which prevents the water from collecting, as may be seen on the Downs, where, in order to get over this difficulty, the ponds dug to collect the rain are coated with clay (or *pugged*, as it is termed locally) to prevent the water from soaking through the chalk. If a heavy fall of rain occurs the streets will be found dry within half an hour after it ceases. The absence of a tidal river or harbour, of course adds greatly to the health of the town, there being no muddy banks to emit unpleasant odours and cause disease. From the Domesday Survey and various ancient records we learn that there was formerly a small river known as the Wellsbourne,

which flowed down the Patcham valley and entered the sea at Pool valley, which forms the remains of the ancient harbour of the town. Eight hundred years ago the whole central valley was a shallow lake, known as the Wellsmere, and from Brighton to Lewes the country was much like the Upper Engadine is now —the valleys occupied with little lakes (cf. Stanmere, Falemere, Burgemere).

Barren Hills.

The absence of trees at Brighton has been to some a subject of complaint, whilst others consider it an advantage. The sea-salt in the wind is unfavourable to vegetation—the *Euonymus*, however, flourishes; but trees are generally stunted. Dr. Johnson, who several times visited Mrs. Thrale at her house in West Street (now the site of the Concert Hall), detested the Downs, and observed that "it was a country so truly desolate, that if one had a mind to hang one's self for desperation at being obliged to live there, it would be difficult to find a tree on which to fasten the rope." An old alliterative proverb refers to Brighton as "a Town without Trees, and a Sea without Ships." Peter Pindar, again, writing in 1802 in praise of Margate, says:—

> "What's Brighton, when to thee compared? Poor thing!
> Whose barren hills in mist for ever weep."

This is, however, a libel, for the town is very free from mist, as I shewed in an elaborate table published in the *Daily Telegraph* of Oct. 1888.* Trees have now been planted by the Corporation in many thoroughfares; but there is no doubt that the general absence of decaying vegetable matter has conduced to the health of the town.

Temperature.

The proximity of Brighton to the sea affects the climate in three ways:—

1. By reducing the mean daily range of temperature.
2. By raising the temperature in the winter months.
3. By lowering the temperature in the summer months.

The appendix to this paper contains a summary of the writer's meteorological observations for more than twenty years, being taken from an article contributed to Mr. D. B. Friend's Brighton Almanack for 1890, to which reference must be made for complete meteorological tables. From Table I. it will be seen that the mean daily range of temperature yearly was 11·8 deg.; being 15·9 deg. in June, diminishing to 7·7 deg. in January. These daily ranges are of course small compared with those of

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* This Table is given on page 256.

inland places. The lowest temperature was 11·4 deg. on January 22nd, 1881 (the time of "the great snow-storm"). On the 15th of that month the min. temp. was 15·5 deg.; on the 17th, 16·7 deg.; and the 20th, 17·3 deg. With the exception of these four days no lower temperature than 18 deg. was recorded, viz., in December, 1870 (the winter of the Franco-Prussian War). This clearly shews the influence of the sea, as in the interior of the country we find the temperature fell below zero at many places. Fashion has, perhaps, somewhat empirically, fixed the Brighton season for the period from the end of September to the middle of December; and it is a curious fact that it is then that the advantages of Brighton are most apparent, the chills of autumn being avoided, and mean temperature in excess of that at Greenwich, as will be seen by the following table:—

MEAN MONTHLY TEMPERATURE.

(arithmetical mean daily max. and min. temperatures.)

	BRIGHTON. Deg.	GREENWICH. Deg.
September	58·0	56·6
October	50·4	49·5
November	43·8	42·4
Mean	50·7	49·5

The mitigating influence of the sea on the heat of summer is apparent, for we find that the temperature has not risen above 90 deg. The highest in my own register during twenty-three years, being 86·7 deg. on July 17th, 1868. During the summer months the well-known phenomena of the land and sea breezes are particularly noticeable at Brighton, the most marked being the easterly. The land breeze N.E. or E. blows until from 10 to 11 a.m., and a morning will open very sultry and oppressive until the cool sea breeze sets in. This lasts until sunset, or sometimes until midnight, when the land breezes begin again. A cool and comfortable day is thus enjoyed, even in the height of summer. When these breezes are westerly, the land breeze is from N.W. or W., and the sea breeze from the S.W. or S., occasionally S.E. Sometimes the land breeze begins in N.E., is followed by S. or S.W. sea breeze and then a N.W. or N. land breeze again, or the reverse way, but this is not often.

The mean temperature of the year (arithmetical mean daily max. and min. temperatures) is 49·8 deg., the monthly means ranging from 63 deg. in July to 38·8 deg. in January. The warmest month in the last twenty-three years was July, 1868, with a mean of 66·8 deg., and the coldest January, 1881, with 33·2 deg.

Wind.

The climate of Brighton has been classed amongst the *bracing*, but this must be from the fact that its pure air is almost always in motion rather from any lowness of temperature, which, as already seen, is not experienced here. In a "Book of Nonsense" (I think by Mr. C. H. Ross) I once read that—

> "There was a young lady of Niton,
> Who went for a visit to Brighton;
> But when she got there, so keen was the air,
> She shivered, and went back to Niton."

Our visitors, however, do not shiver and leave the town, but find it a pleasure to return again and again, as I trust will be the case with the members of The Sanitary Institute.

From September, 1872, to December, 1874, the velocity of the wind was recorded by me with a Robinson's anemometer, erected at the Chain Pier-head, Brighton; and from the observations of twenty-seven months it appears that the mean horizontal distance travelled by the wind daily during that period was 329 miles, or nearly 14 miles an hour, so that there is no lack of fresh air.

Rainfall.

The mean annual rainfall of twenty years was 28·35 inches; and as will be seen by Table III., the most rainy month is November, with a total of 3·40 inches; and the driest, March, with 1·67 inches. The greatest fall in twenty-four hours was 1·99 inches, on June 22nd, 1876, being the largest recorded by any observer in Brighton. It is somewhat remarkable that no heavier fall of rain has occurred, but it may be due to the fact that the town is very free from thunderstorms and that there is no river-bed up which a storm can travel. Thunderstorms have often been observed approaching the town from the sea, and then either dividing into two parts and proceeding up the channels of the Ouse and Adur (the two neighbouring rivers), or else passing undivided along one of them. In either case Brighton only experiences the edge of the storm.

Sea Bathing.

It seems wrong to conclude a paper on the climate of Brighton without briefly drawing attention to the important matter of sea-bathing, to which the town first owed its popularity. It must be confessed that this is now sadly neglected. We find people going abroad at great expense to try foreign baths, when a course of salt-water baths here would be found of great benefit, particularly in strengthening and bracing the limbs of delicate children and women. Formerly, it seems that people were not

so much afraid of the sea as at present, for we read of Dr. Johnson bathing here in October, 1776, a month when sea bathing has now usually ceased. His friend Mrs. Thrale invited him here expressly for the bathing, and the attendant on seeing Johnson swim, said "Why, Sir, you must have been a stout-hearted gentleman forty years ago!" Later on we find the gossiping Fanny Burney, bathing in November, and writing thus in her "Diary":—

"Wednesday, November 20th [1782]—Mrs. and the three Miss Thrales and myself all arose at six o'clock in the morning, and 'by the pale blink of the moon' we went to the sea-side, where we had bespoke the bathing-women to be ready for us, and into the ocean we plunged. It was cold but pleasant. I have bathed so often as to lose my dread of the operation, which now gives me nothing but animation and vigour. We then returned home, and dressed by candle-light, and, as soon as we could get Dr. Johnson ready, we set out upon our journey in a coach and chaise and arrived in Argyle Street at dinner time."

It is a matter of great surprise to me that the Corporation do nothing to encourage sea-bathing, and do not provide for the poorer classes any sheltered baths to be used in stormy or inclement weather, or indeed any form of salt water baths.

We have an excellent Chalybeate spring now known as St. Ann's Well, containing (as I learn from several medical works) one of the most powerful iron waters in England, and I am assured by medical friends that four persons out of every five would enjoy better health by taking small doses of iron regularly as a tonic. In conclusion, therefore, I cannot do better than advise strangers to invigorate themselves with our pure fresh air, and to strengthen themselves by sea-bathing and a course of these iron waters.

APPENDIX.

Summary of Observations made at Nos. 55 and 31 Buckingham Place, Brighton.

The observations were made in latitude 50° 49′ 56″ N. and longitude 0° 9′ 13″ W. The instruments used being verified standards chiefly by Negretti and Zambra and Casella. They were 206 feet above the mean sea level as calculated by the Ordnance Survey Officers. The air thermometers were exposed on an open modified Glaisher stand with a N.W. aspect. The readings of the maximum and minimum thermometers were taken respectively at 9 a.m. and 10 p.m. daily until December 31st, 1876, and after that date both at 10 p.m. until September 30th, 1886, when they were taken at 9 a.m. daily. The rain-

guage had a 5-inch funnel, and was, until the middle of 1874, placed one foot above the ground, and then on a post five feet above the ground to obtain better exposure. It is considered, however, that all the observations are equally comparable. Rainy days are those on which ·01 of an inch or more of rain, snow, or hail fell. The mean degree of humidity is calculated (by Glaisher's Hygrometrical Tables) from the difference between the dry and wet bulk thermometers. It represents the percentage of moisture the air contains.

Table I.—*Air Temperature in the Shade.*
(21 Years—1868 to 1888.)

Months.	Max.	Date.	Min.	Date.	Range.	Mean Daily Max.	Mean Daily Min.	Mean Daily Range.	Mean.
	Deg.		Deg.		Deg.	Deg.	Deg.	Deg.	Deg.
January ...	54·7	19, 1877	11·4	22, 1881	43·3	42·6	34·9	7·7	38·8
February ...	56·7	27, 1868	20·5	12, 1870	36·2	44·5	36·2	8·3	40·3
March	61·4	30, 1873	22·8	11, 1874	38·6	47·3	36·2	11·1	41·8
April	71·5	28, 1869	27	21, 1881	44·5	54·2	40·6	13·6	47·3
May	78·5	27, 1868	31	8, 1879	47·5	60·3	45·1	15·2	52·7
June	79·8	16, 1870	38	4, 1871	41·8	67·1	51·2	15·9	59·1
July	86·7	17, 1868	42·6	16, 1883	44·1	70·5	55·4	15·1	63
August	84·5	17, 1876	43·3	23, 1885	41·2	69·5	55·3	14·2	62·4
September ..	77·2	7, 1868	34	27, 1885	43·2	64·3	51·8	12·5	58
October	72·0	8, 1869	27	28, 1869	45·0	55·8	44·9	10·9	50·4
November ..	60·4	14, 1876	24·6	30, 1879	35·8	48·3	39·5	8·8	43·8
December ...	56·4	1, 1876	18	23,* 1870	38·4	43·6	35·6	8·0	39·6
Results	86·7	July 17, 1868	11·4	Jan. 22, 1881	75·3	55·7	43·9	11·8	49·8

* Also 24th and 30th.

Table II.

Barometrical Pressure (14 Years—1872 to 1885. Corrected and Reduced to 32 degrees at Sea-Level.							Mean degree of humidity, 9 a.m. Saturation = 100 per cent.
Months.	Highest.	Date.	Lowest.	Date.	Range.	Mean at 9 a.m.	
	Inches.		Inches.		Inches.	Inches.	
January.........	30·983	1882	28·514	1872	2·469	30·058	91
February	30·868	1883	28·902	1873	1·966	29·968	91
March	30·741	1883	28·437	1876	2·304	29·974	82
April	30·635	1883	28·981	1879	1·654	29·890	76
May	30·645	1881	29·144	1885*	1·501	30·001	72
June	30·504	1874	29·487	1881	1·017	29·992	73
July	30·471	1882	29·206	1877	1·265	29·991	73
August	30·490	1874	29·179	1876	1·311	29·966	74
September ...	30·523	1873	28·867	1883	1·656	29·971	81
October.........	30·644	1877	28·885	1880	1·759	29·924	85
November......	30·656	1879	28·618	1880	2·038	29·924	88
December......	30·818	1879	28·515	1876	2·303	29·977	90
Results	30·983	Jan. 18, 1882	28·437	Mar. 12 1876	2·546	29·970	81

* On May 13th, 1886, the reading at 9 a.m. was 29·101.

TABLE III.

Months.	Rain. (20 Years—1869 to 1888.) Mean Monthly Fall.	Greatest fall in 24 hours.	Date.	Mean No. of Rainy Days.	Minimum Temperature on Grass. (1870 to 1885—16 Years.) Mean.	Lowest.	Date.	Mean. No. of Nights at or below 32 deg.
	Inches.	Inches.			Deg.	Deg.		
January	2·72	1·09	10, 1877	16	31·7	8·7	22, 1881	17
February	2·13	1·02	26, 1874	15	33·0	18·8	24, 1875	13
March	1·67	0·75	11, 1885	13	33·1	15·5	14, 1870	14
April	1·68	0·94	16, 1871	12	36·9	22·5	25, 1875	6
May	1·72	1·21	28, 1878	11	41·3	26·0	3, 1877	3
June	2·00	1·99	22, 1876	11	48·2	34·3	17, 1883	—
July	1·88	1·52	14, 1875	12	51·7	38·7	16, 1883	—
August	2·33	1·23	19, 1879	12	51·3	39·0	24, 1887*	—
September	2·80	1·54	3, 1884	13	47·4	26·8	23, 1872	—
October............	3·30	1·27	22, 1870	16	40·7	21·6	31, 1873	3
November	3·40	1·41	18, 1880	17	34·5	21·8	19, 1871	12
December	2·72	1·06	13, 1870	15	31·2	11·3	27, 1870	17
Results of Year.	28·35	1·99	June 22, 1876.	163	40·1	8·7	Jan. 22, 1881.	85

* Also August 19th, 1885.

Mr. BALDWIN LATHAM (London) said that he did not know any one in the county who had done more valuable work in meteorological research than Mr. Sawyer. Few people knew the great value of a thorough pursuit of meteorological study. It was extremely important to the Sanitarian, and Mr. Saywer's observations, it was interesting to know, appeared in the Registrar-General's returns, and in the Annual Summary. Brighton, in fact, was one of the very few towns in the Registrar-General's returns, from which observations were not absent. Therefore Brighton set a good example, which he trusted other towns would follow, so that they might have a record of the observations in all the large towns. There could be no doubt whatever that the study of meteorology threw great light on the causes of unhealthy years; those years, in which there was a more free movement of the air, were found to be the most healthy. He also suggested that a survey should be taken of the level and movements of underground water.

Mr. W. WHITE (London) asked why, in so many towns which excelled as sanitary resorts, there was so little attempt to soften the water?

Alderman Dr. EWART (Brighton) replied that the question of softening the water had been most carefully considered by the Town Council. Proposals had been made to soften it, as it issued from the chalk at Goldstone Bolton. But when the question was carefully

gone into, it was found that the water was not sufficiently hard to justify the town in undertaking the consequent expense. Nor did they care to undertake the risk of having their water supply contaminated at the fountain head, which the establishment of such works might involve. But the real fact of the matter was, that putting this question aside, the water of Brighton was not sufficiently hard to demand any such procedure. In cases of rheumatism, gout, dyspepsia, hard water, he admitted, would be more or less injurious. But then they had by Clark's process a means by which every householder could soften his own supply. As invalids in Brighton were the exception to the rule, he thought that it would be absurd to soften the water of a great community for the sake of those who were in a very small minority, and who could gain the end they wanted for themselves with very little difficulty. As showing the wholesomeness of Brighton water, he said they would not in all England find a healthier community of children than in Brighton.

Sir Thomas Crawford (London) said that all who had seen the magnificent waterworks possessed by Brighton, must be convinced of the admirable arrangements made by the Brighton authorities for securing the purity of their water supply, and the best arrangements for its distribution. He had personal experience of the hard water at Blackheath, as supplied by the Kent waterworks. It was very much harder than the water supply of Brighton, but there was one thing to be specially noted, and that was the healthiness of the Blackheath children. He did not think that a little chalk in the water was by any means a bad thing, nor did he believe that Brighton would be doing wisely by attempting to soften its water. Proceeding, he mentioned for example Dublin, which was perhaps the unhealthiest town in the United Kingdom, to show that a pure and soft water supply was not the only feature necessary to secure health.

As the discussion had taken an unexpected turn with regard to the softening of water, the President of the Section suggested that Mr. Baldwin Latham, a great authority on the subject, might like to add to his previous remarks.

Mr. Baldwin Latham (London) accordingly availed himself of the opportunity to say that as far as the purposes of washing were concerned, it was desirable to soften the water. It was a fact, however, that the healthiest districts were those where the water supply was hardest, whilst it was only extremely soft water that produced lead poisoning. With reference to the Kent Waterworks Company, they had studied this question. The first thing they did was to buy a waterworks having a softening process in full operation. Very soon, however, they abandoned this process and delivered the water in its natural state, thus adding their testimony to the many difficulties there were in softening water on a large scale. In his own house he boiled all the water, put it in the open air to cool, and then filtered it, with the result that as far as the taste was concerned, no

difference could be detected from the water in its original state, in point of fact, however, the process of boiling the water was the means of removing its hardness. Chalk water, he added in conclusion, was an admirable water, and all districts supplied by it were undoubtedly healthy.

Mr. G. J. SYMONS (London), referring to the meteorological observations conducted by the Medical Officer of Health for Brighton, observed that though the rain gauge and the thermometer might not be considered artistic apparatus, he should like to see them occupying better positions on the Old Steine, and not half hidden as they were by trees. He further suggested that, as the temperature of the Old Steine did not truly represent the precise temperature all over Brighton, it would be valuable and interesting for similar instruments to be placed, say, near the Hove sea wall, and near the Madeira Road. Why, the very fact of there being a Madeira Road—a sheltered drive by the sea—was itself evidence that the temperature there was considered higher than at many points elsewhere in Brighton. He was sorry that Mr. Sawyer's table on the mists in Brighton had been published in the *Daily Telegraph*, and not in the proceedings of any Society where it would be accessible.*

Dr. EWART (Brighton) explained that this table had been prepared in compliance with a request from the Corporation, when it was thought that the New Wimbledon would be at Brighton. He, however, suggested that it should be added to Mr. Sawyer's present paper, so as to be preserved in the Transactions of The Sanitary Institute.

As Mr. Sawyer, owing to indisposition was not present, there was no formal reply, nor did Mr. SYMONS, who undertook the introduction of the paper, think that there were any points which required explanation. A cordial vote of thanks was passed to Mr. Sawyer for his communication.

On "Lead Poisoning by Soft Water-supplies," by Professor PERCY F. FRANKLAND, Ph.D., B.Sc. (Lond.), Assoc. Roy. School of Mines, F.C.S., F.I.C.

THE subject of lead-poisoning is one which has, during the past few years, been again very prominently before the public, in consequence of several notable cases of such poisoning having taken place in different parts of the country.

Indeed it is, perhaps, one of the most remarkable features of

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* This Table is given on page 256.

this subject that, although the sources of water-supply remain unchanged for long periods of time, still the mischief in question is often lost sight of for a number of years, and then again makes its appearance almost after the fashion of an epidemic. This periodical publicity is no doubt to a certain extent a matter of accident; but it is also unquestionable that one and the same water-supply may have the power of acting upon lead at one time, and become inactive at another.

If we enquire into the cause of this activity, we find that opinion at the present day is even more divided than in the past; according to some authorities it is due to the presence of acidity in the water, according to others the cause is to be sought in an insufficiency of dissolved silica, whilst others again see, in the absence of a certain proportion of dissolved carbonic acid, the secret of the lead-dissolving power.

Time does not permit me here to enter into the evidence upon which these theories are severally based, but their mere enumeration must be sufficient to show that our knowledge of the cause or causes of this lead-dissolving power of some waters is in a very unsatisfactory state, and that at present at any rate the mischief and its remedy must be treated from a purely empirical point of view.

It is not necessary, indeed, to predicate this lead-dissolving power of every water until the reverse has been actually demonstrated by experiment; on the contrary, the experienced chemist, from a mere inspection of the results of an ordinary analysis, is able to predict, with almost unerring certainty, the innocence of the great majority of inactive waters in this respect; whilst, on the other hand, he will have far greater difficulty in foretelling with precision the activity of water towards lead from analytical data alone. He should, however, relegate all very soft waters to a doubtful class, the individual members of which must be subjected to careful experiment before being cleared of the suspicion of possessing activity towards lead.

Methods of Examination.

There can be no doubt that in general water-analysts devote too little attention to the question of the lead-dissolving power of the waters submitted to them for opinion; for this, however, they are not wholly, nor indeed chiefly, to blame, as the adequate investigation of this subject entails a larger expenditure of time and the use of a much larger quantity of water than are generally available for such analyses. It is, however, in my opinion, incumbent upon the water-analyst to indicate to his

client, whenever there is any chance of a water proving troublesome in this respect, that a special investigation of this point is desirable.

Especially noteworthy and regrettable is the absence of any adequate treatment of this important subject in the very comprehensive labours of the Royal Commission of 1868. As a result of this neglect we find that soft waters generally, when free from any suspicion of sewage contamination, have been recommended without caution for the purposes of town supply, and have been left to demonstrate their lead-dissolving power by the cases of lead-poisoning to which they have at times given rise.

The examination of water for activity towards lead, if it is to be satisfactory, must be conducted with much circumspection and care. It is not sufficient to place a strip of metallic lead in contact with a certain quantity of the water, and then watch the result, but the water should be placed in a piece of lead service pipe closed at both ends, and after remaining there for a definite length of time (say twenty-four hours) the amount of lead in suspension and solution should be carefully determined. It must be further borne in mind that some waters act more upon new lead than upon old, whilst others act upon the old or corroded metal more than upon the bright untarnished surface; and on this account it is very desirable that the above test should be made with a piece of new service pipe as well as with a piece of an old one. And again, the tests should be continued over as long a period of time as possible in order to watch the progress of the action.

Thus in some cases it will be found that the water acts more upon the new pipe than the old, and *vice versa;* sometimes that the water acts more and more upon the pipe from day to day, and *vice versa;* so that experiments made only with a new, or only with an old pipe, as well as experiments not continued over a sufficient period of time, would lead to most erroneous inferences being made. As regards the use of old pipes, these should of course have been in use with the water under examination, otherwise no satisfactory deductions can be made, and hence if it is a question of a new water-supply, the important matter is to observe whether, with a new pipe, the amount of lead in suspension and solution increases or diminishes from day to day.

If the quantity of lead taken up by the water diminishes from day to day, and soon falls to an insignificant amount, it may be safely assumed that the water will exert no permanent action on lead. On the other hand, if the proportion of lead taken up is considerable and remains practically constant, or actually increases from day to day, the obvious inference is that the

activity will be permanent, and inasmuch as by corrosion the surface of the pipe is enormously increased, larger and larger quantities of lead will in all probability be taken up by the water.

A very curious feature, which is worthy of notice in connection with such tests as the above, is that a pipe of small diameter, although offering a larger surface to the water it contains than a wider pipe, still yields less lead to a given volume of an active water placed in it, than a pipe of greater diameter. The explanation of this is probably to be found in the fact that the corrosion of the pipe takes place from definite centres on the surface of the lead in consequence of some irregularity, mechanical, physical, or chemical, of the surface, and a larger tube with its larger surface naturally possesses a greater number of such centres from which corrosion can take place.

Classification of Waters.

As regards the waters which should be submitted to examination in the manner indicated above, it may be stated that hard waters, especially those containing so-called "temporary" hardness, may be generally considered above suspicion, although cases are by no means unknown of hard waters, generally from polluted shallow wells, which have a powerful action upon lead.

On the other hand all soft waters, and even hard waters which contain little or no "temporary" hardness, must be provisionally viewed with suspicion until a searching enquiry has been made into their behaviour towards lead. The suspicion of activity in the case of such soft waters becomes the greater if they are highly impregnated with vegetable matter, as they often are when derived from moorland districts. Such vegetable matter often imparts a measurable acidity to the water, although in my opinion it is quite possible for such moorland waters to be possessed of high lead-dissolving power without any acidity, and indeed after an appreciable quantity of alkali, in the shape of bicarbonate of lime, has been added to them. It must also be borne in mind that acidity cannot be indispensable to activity inasmuch as distilled water is possessed of strong lead-dissolving power.

As already mentioned, some authorities attribute the continuous activity of waters to the absence of an adequate proportion of dissolved silica in them, and although the evidence in favour of this supposition is by no means conclusive, and is indeed in direct opposition to the experience of others, there can be no doubt that whilst this matter is still *sub judice*, such waters should be remanded for further enquiries.

It is, further, of the greatest importance to remember that

the activity of water, especially surface water, from the same source is extremely variable at different times and seasons, and that consequently a favourable opinion passed upon a water of a suspicious type must by no means be supposed to clear its reputation for all time. It is very necessary that Medical Officers of Health of towns supplied with such waters should be continually on the alert, that they should frequently have the water drawn from the service-pipes submitted to examination, for in all probability there must be an immense amount of lead poisoning of an inconspicuous character which is never brought to public notice at all, especially when it is remembered what powerful motives there are for concealing any dangers attaching to a public water-supply.

Public Protective Measures.

Assuming that the activity of a water towards lead has been demonstrated either by experiment or by actual experience on the large scale, the question arises as to what means are available for its prevention. Various preventive measures have from time to time been suggested with more or less success.

In the belief that the activity is in general caused by the acidity of the water, it has frequently been recommended to pass the latter through filters constructed of chalk or limestone. This comparatively simple measure has been found to be fairly successful in certain cases; but the effect is of only short duration, as the chalk or limestone soon becomes coated with a furry deposit, which prevents its further solution by the water.

On the assumption that the presence of silica is essential to secure the inactivity of the water, filters constructed of sand, flint, and limestone have been recommended, and found to be efficacious, at any rate for a certain length of time. I have myself experimented with filters thus constructed, and have found that the activity of the water was very materially diminished by such filtration, although the proportion of silica was not materially increased. Adequate data are, however, wanting as to the length of time during which such filters remain efficacious.

Of all the methods of preventive treatment with which I have experimented, by far the most efficacious consists in the addition of a certain proportion of carbonate of soda to the water. I was first led to employ this method in the case of an extremely active water, which was found otherwise very difficult to deal with, and in which an immediate remedy was requisite. The method proved perfectly successful in the case of this highly refractory water, and has been since imitated with

success in other places. In addition to its efficiency, the method possesses the advantage of avoiding the expensive erection of filter-beds, with the necessary frequent renewal of the filtering material; again, the dose of carbonate of soda can be varied according to the necessities of the case, and even with the same water it may advantageously be varied from time to time, inasmuch as the activity, in the case of surface-water, generally varies much with the season.

I have found this method of treatment with carbonate of soda far more effective than the addition of any other chemicals that I have experimented with, thus it is much more effective than caustic lime, and much more easy to handle; it is also much more effective than phosphate of soda, which has sometimes been supposed to act powerfully as a protective towards lead, but which I have found to be of absolutely no use unless employed in prohibitively large proportions.

As regards the quantity of carbonate of soda it is necessary to add, this must be ascertained by actual experiment in every particular instance; but in an extreme case I found it necessary to use five parts of soda to 100,000 parts of water by weight, which, with carbonate of soda at £5 a ton, represents a cost of 3d. per 1,000 gallons. In most cases, probably, a very much smaller amount only is necessary, and if the quality of a water-supply be watched from time to time, the amount could be frequently varied, and at certain seasons probably the treatment might even be suspended with safety.

But although I am of opinion that treatment with suitable proportions of carbonate of soda is the safest and most expeditious method of counteracting the lead-dissolving power of a soft water, I do not wish to discountenance the treatment of such waters by filtration. On the contrary I think it is very desirable that upland surface waters should be subjected to filtration quite irrespectively of their activity towards lead, although the fact that this activity is often very greatly diminished by filtration through suitable materials, forms an additional and strong argument for submitting all such waters to this salutary process.

Private Preventive Measures.

In conclusion, I would point out that it is the duty of the medical officer of health, or of any other local sanitary authority, to see that in all towns supplied with water which is known at times to possess activity towards lead, the consumers are duly informed of the best means of protecting themselves individually, from the dangers of lead-poisoning. This would probably be

best effected by the periodical house to house distribution of a suitable leaflet pointing out :—

(1.) That no water should be collected for drinking purposes, until after the tap has been allowed to run for such a length of time as will presumably clear the service pipe, and that the drinking or cooking water, may, therefore, be advantageously collected immediately after a considerable quantity of water has been drawn for other domestic purposes.

(2.) That the filtration of the water through any form of animal charcoal filter practically guarantees its absolute freedom from lead.

(3.) That hot water acts more powerfully on lead than cold, and that, therefore, metal tea-pots and other soldered vessels for holding hot water should be avoided as much as possible.

"*A case of Well-pollution undetected by Chemical Analyses*," *by* A. W. Scatliff, D.P.H., Medical Officer of Health for Margate.

A somewhat interesting series of six cases of enteric fever, probably communicated by water from a contaminated well, and exemplifying Dr. R. Cory's investigations, recorded in the Medical Officers' Supplement to the Local Government Board's 11th Annual Report, occurred in my district last summer. These six cases, except the first, all originated in two houses situated next door to one another on the outskirts of the town, and drawing their supply of drinking water from a well used in common by the inmates. The following table gives at a glance a few particulars of the order of the appearance, &c., of the malady in each one of the affected persons :—

House No. 1.			House No. 2.		
No. of Case.	Name.	Date.	No. of Case.	Name.	Date.
1st	Mr. C.	Early in July.	4th	Mrs. F.	Oct. 1st.
2nd	Mr. M.	Aug. 5th.	5th	Mr. F.	Oct. 25th.
3rd	Mr. P.	Aug. 5th.	6th	Miss F.	Nov. 2nd.

The first case, that of Mr. C., was clearly imported, the symptoms showing themselves in a locality previously free from the disease, a few days after his arrival. The interest of the succeeding batch centred in the fact that the Public Analyst reported that the well water, although of doubtful purity, was not, in his opinion, a safe case to "carry into court," and yet five other cases subsequently were probably caused by persons drinking of this identical water. Careful investigation of the circumstances seemed to show that this well had become contaminated (although previously safely used for years), by the specific enteric poison derived from the stools of the first patient. It appeared that there was no water-closet in House No. 1., and that Mr. C.'s evacuations were placed in a dry closet some 40 feet from the house. The trouble which ensued was, however, probably produced in the following manner:—The pail from which the stools had been emptied was usually dipped into a rain-water tub to rinse it clean, and the washings were subsequently thrown on the ground in close proximity to the well, and thus, in all likelihood, polluted it.

Another point of importance duly noted was that, on my advice, the inmates of House No. 2 did not partake of the affected water from August 5th until about September 23rd; at the latter date, the landlord of the house, who had been pressed to amend the water supply and close the well, stated that he should not do so, as he had had the water analysed, and it was reported good, and on the strength of his statement, Mr. F.'s family used the water again, with the result that Mrs. F. was attacked by typhoid fever on October 1st. This was sufficient to convince the landlord, as well as Mr. F., of the serious mistake they had made, and the water was at once laid on without further delay. Notwithstanding this, however, the husband and one of his daughters, who rarely drank water until boiled (in contradistinction to the mother, who frequently drank it fresh from the well) contracted the same disease on October 25th and November 2nd, respectively. After the latter date no other persons were attacked, although others resided in the affected houses. Of the six persons, only *one*, viz., Mrs. F., died, but her daughter, who was the last to suffer, was very dangerously ill for six or seven weeks. These cases, I think, emphasize Dr. Cory's conclusions, that it is unsafe to trust to chemical examination of water, unless we have persuaded ourselves that the source of it is free from pollution.

Mr. Baldwin Latham (London) said that his view of chemical analysis was very conclusive. He never trusted to it. On the other hand, he never supplied a town with water unless he did have a chemical analysis, because, if a chemist said the water was bad no one would use it. With regard to organic chemistry it had not made much advance in this matter, and he pointed out in this connection the anomaly, that whilst a chemist said, if water contained 10 parts of a certain ingredient it was bad, yet, if he put more water to it and reduced the parts of the ingredient to four, the chemist then held that it was good. Further, in order to test the value of a chemist's analysis, the Local Government Board had charged certain water with the excreta of persons suffering from typhoid fever, and other water with the excreta of persons who were perfectly healthy, and significantly enough, whilst the latter was condemned, the water containing most poisonous matter passed muster as good water. In the great fight about the Middlesborough water, Dr. Frankland, the greatest chemist of the present day, said in evidence, that he had charged water of a good quality with a certain quantity of the excreta of persons suffering from cholera, in the proportion of one part per thousand; he had submitted it to analysis, and he had not been able to find any difference in it from pure water. Wells, therefore, which were liable to pollution were, he held, to be looked upon with great suspicion, even though the water in them passed the test of the chemist. Whilst, however, there was this uncertainty in the chemist's test, they had certain minerals in whose power they could absolutely rely. There was for example the lithia test, it being possible for one three-hundred-thousandth part of a grain of lithia to be detected by spectrum analysis. This lithia moved with the water, and by it it was quite possible to trace where the water went, in what particular direction; so, though chemists could supply no accurate test of water by organic chemistry, they had in this way rendered it possible to trace water underground for long distances. As a piece of general advice he would say, "use your common sense in doubtful cases, and always boil your water before drinking it."

Mr. Jago (Brighton) considered it worthy of remembering that no analysis by organic chemistry was of use in tracing germs of typhoid or other diseases. The most the chemist could do in this way was to pass a general condemnation, distinguishing only the difference between water fairly bad and very bad.

Mr. H. H. Collins (London) said that in Paddington they had recently had an inspection of water, and Mr. Latham had certainly told them exactly what the water contained, and they had blindly trusted the opinion he offered them. He could only say, therefore, that he hoped Mr. Latham had spoken of chemists' tests with the due caution that a gentleman making such assertions should do, for his remarks were such as seriously to disturb those who, like himself, had to do with the administration of Acts of Parliament. For himself he was rather

of opinion that Mr. Latham had conveyed a wrong impression of Dr. Frankland's evidence in the Middlesborough case, nor could he believe the analysts were quite so ignorant on the subject as Mr. Latham would have them believe. Mr. Latham's remarks, at any rate, had placed him in this position, that when he returned to London he should feel bound to make very careful and anxious enquiries, whether the analyst's science was a mere delusion or founded on fact, and whether chemistry was a myth or the means of teaching them what they wanted to know.

The PRESIDENT of the Section pointed out that Mr. Scatliff's paper would have been of additional value if it had gone a little more into details of the case. And many would have liked to know, for example, the conditions surrounding the well. It would seem, he added, if the statement were correct, that some people had suffered from the effects of the poisonous water even after it had been boiled; that the boiling of water did not absolutely destroy the germs of disease.

Mr. SYMONS (London) said that he had been engaged in the Middlesborough water fight, and would endeavour to supply the shorthand writer's notes on this point, so that they might be printed in the Transactions.*

Dr. SCATLIFF (Margate) in reply, said that his object was to emphasize the point that well-water, even after it had passed the chemist's test, might still contain some germs of disease. Mr. Latham had called attention to the fact that chemists had great difficulty in detecting specific organic germs in water. They were so minute that it was not safe, even after the analysts' report, for people to drink water the source of which was exposed to unhealthy surroundings. Wells should be regarded with suspicion, especially if they were in the neighbourhood of a town. With reference to the point raised by the President, it was an established fact that the action of boiling water would not destroy all germs of disease, though of course boiled water was safer than well-water in its original state.

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* *Stockton and Middlesborough Water Bill, House of Commons*, 1876. *Extract Evidence of* Dr. E. FRANKLAND, F.R.S. 483. "Can you always, by chemical analysis, detect matters which may be very injurious to the health of the persons drinking the water?" "No, you cannot. I have already proved in the cholera year of 1866 that the evacuations of cholera patients, mixed with a thousand times their volume of water, were undetectable by chemical analysis." 484. "Would that dilution be such as to destroy the probability of the communication of disease?" "No."

On "Sanitation in Bread-making," by W. Jago, F.C.S., F.I.C.

ABSTRACT.

Good bread should possess the following properties—Best possible composition, be made by the best processes, and under conditions ensuring absolute cleanliness.

The composition is governed by that of the wheat, but bran-free flour is far superior to preparations in which bran is present. The bran does not add to the nourishing properties of the flour, and injures its keeping and other properties. The difference between white and dark flour is largely caused by the latter being contaminated with dirt from the wheats. Bread should be free from all adulterants; alum where used at all, is much more likely to be employed with inferior kinds of flour. A recent preparation of the germ or embryo of wheat, mixed with fine flour constitutes a valuable article of diet. "Germ bread," prepared from this mixture is exceedingly rich, both in flesh and bone forming materials.

Among the processes used in the manufacture of bread, that of fermentation is far superior to any other mode of aeration. It induces changes in the gluten which render that substance more digestible, and hence far more nourishing flours are employed in conjunction with fermentation than in other processes. Further, fermentation induces an exceedingly pleasant characteristic flavour, unattainable by any other means. The aeration of bread by yeast is in itself a safeguard against the employment of unsound flours.

It is an essential of sanitary bread-making, that all operations involving severe labour be performed by machinery. The most crying among all the evils of ordinary bread-making is that of the dough being kneaded by hand; for this purpose the public should insist on the adoption of mechanical appliances by the baker. Bread should be baked in ovens, free from ashes and smoke, and then allowed to cool in a special room of moderate temperature.

On "The Ill Effects of Floods on Health; illustrated by Facts from the Basins of the Thames, the Severn, and the Mawddach," by ALFRED HAVILAND.

IF we examine the map of Cancer Distribution (females), 1851–1860, it will be seen that throughout the West coast of Wales the districts are so coloured (red) as to indicate a *low* mortality from this cause among females; one exception, however, is to be seen in the dark-blue district of Machynlleth, to the north of which lies that of Dolgelly, so coloured, however, as to show that the prevalence of this disease, in that district, was only just *below* the average; therefore, sufficiently high to make one suspect the prevalence of floods somewhere within the district, and at a point where the population was so great as to dominate the death-ratio of the whole area.

On the 31st May, this year, I began my reinvestigation in the Dolgelly district, some of the results of which I will lay before the Congress, leaving the more technical details for the future consideration of my medical brethren.

In the first place it must be stated that the district of Dolgelly consists of two sub-districts, both of which have natural boundaries and certain physical characteristics, which I will briefly describe.

1. *Talyllyn* sub-district derives its name from the town "*above the lake;*" and 2, *Barmouth* sub-district from Abermaw, the *estuary* of the Maw or Mawddach.

These sub-districts lie almost parallel to each other, and each has a separate river system. In 1871–80, *Talyllyn* had a mean female population of 3,088, whilst *Barmouth* had one of 4,605.

The local climates, however, of the two sub-districts, as well as their local configuration, although lying side by side, separated only by the Cader Idris chain of mountains, differ *toto cœlo* from each other.

In the first place *Talyllyn* is almost bisected, lengthways, by a deep, cleanly cut valley, having a direction S.W. to N.E., through which the prevailing winds blow with great force—a fact that must be remembered when dealing with the death-rates from phthisis. In this valley lies the lake, which acts as a water-store, and prevents floods.

In the second place the sub-district of *Barmouth* includes Dolgelly, the most populous parish in the district; its river valley is broad, and characterised, as will be seen by the Geological Survey Map, by extensive alluvial flats, which

stretch far above Dolgelly and Llanelltyd, the two highest parishes in the district. At the mouth of the river is the Bar, and the extensive estuarian sands, which impede the river-flow, hold back freshets, and, combined with tides, contribute materially to the floods which extend even to and above Dolgelly.

The Severn.—Recently I have drawn the attention of my medical brethren to the causes conducing to the increase of cancer among females,* amongst which stand, first and foremost, *floods.* I must only draw your attention to the high mortality districts, which surround the well-known flooded areas through which the Severn passes, to convince you of the coincidence of high mortality from this cause, and the seasonal floodings of such fully-formed rivers as the one on which the high mortality districts of Shrewsbury, Worcester, Upton-upon-Severn, Tewkesbury, and Gloucester are situated.

The Thames.—If now we trace the Thames along its course, we shall find that, wherever the riparian districts are seasonally flooded, and consist of retentive clays, there is to be found the highest mortality from cancer among females; it is noteworthy, however, that both above and below London there are low mortality districts to be found where the *chalk* crops out. This formation, consisting as it does of carbonate of lime, has a powerful neutralising effect upon the acids, the results of vegetable putrefaction, the common sequel of floods, and the source of certain peculiarities in the local climates of flooded areas. These low mortality districts are found at Cookham and Wycombe above, and at Dartford and Orsett below London.

The floods of the Thames are still to be dealt with by the engineer; in fact wherever they exist as permanent sources of disease, it becomes imperative on those having jurisdiction over rivers and water-courses, to take measures for their prevention.

The facts connected with the basins of the Mawddach and the Talyllyn valley may be summed up as follows:—

The district of Dolgelly includes the Mawddach valley and that of Talyllyn; its death-rate from any cause would, therefore, to a certain extent, be the result of composite factors.

On the one hand a local climate influenced, especially inland, by flooded areas; on the other hand a local climate characteristic of the presence of lake-water, and freedom from floods.

Last year I showed † that the local climates of the English Lake District, brought about by the constant movement of its lake waters, its torrential rivers, cascades, &c., and absence of floods, stagnant water, and vegetable decomposition, was co-

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* *The Lancet*, 9th August, 1890.
† *The Lancet*, 14th September, 1889.

incident with a remarkably *low death*-rate from cancer among women.

Within the Dolgelly district we have comprehended a *flooded* area and a *lake area.* Taking the district as a whole, we of course take the results of these conditions in their modified forms, as will be seen by the following figures and the coloured maps, which accompany this paper.

On the map of England and Wales, showing the geographical distribution of cancer (females) for 1851—1860, it will be found, as already pointed out, that the district of Dolgelly is coloured light red, indicating a mortality just below the average.

Now, if we take the mean *death*-rate from cancer among females for the thirty years, 1851—1880, to be 5·5 annually to every 10,000 of that sex living, we shall find that the following figures and colours apply to Dolgelly :—

		Males.		Females.
1851—1860.	Death-rate	1·4	..	3·6
1861—1870.	,, ...	3·4	..	5·1
1871—1880.	,, ...	6·1	..	7·8

By which it will be seen that this disease has greatly increased among both males and females.

If we now separate the sub-districts, we shall soon see on which the burthen of this increase has fallen.

1871—1880.

Sub-district.	Mean Population.		Total Deaths.		Death-rate.
Barmouth	3,976 Males....	..	31	..	7·7
,, ...	4,555 Females..	..	47	..	10·3
Talyllyn	3,126 Males....	..	13	..	4·1
,, ...	3,088 Females..	..	13	..	4·2
Dolgelly	7,102 Males....	..	44	..	6·1
,, ...	7,643 Females..	..	60	..	7·8

For 1851—1860, the colour for the female death-rate, 3·6, would be *light red*, being between 3·5 and 5·5.

For 1861—1870, the colour would still be light red, as the death-rate, 5·1, remained still below 5·5, although it had risen.

For 1871—1880, the death-rate having increased from 5·1 to 7·8, the appropriate colour would then be the *darker blue shade.*

If we now examine the figures and colours of the two sub-districts separately, the contrast is so obvious that it will not require a second glance to convince us which local climate had the greatest share in this female cancer death-rate of the Dolgelly district, for at least the decennial period 1871—1880. Thus in the (1) *Barmouth sub-district* the death-rate = 10·3, and in (2) *Talyllyn sub-district* the death-rate = 4·2 ; so that the *first* would be coloured the *darkest blue*, and the *second light*

red, which is exactly what we should be led to expect from our experience throughout Great Britain.

It is impossible to ignore the connexion between these local floods and the prevalence and increase of cancer among females; and it is because I am convinced that they are the great factors in local climates which favour the development of this fearful cause of death, that I bring this subject before an Institute numbering so many eminent engineers among its members, in the hope that through their skill and influence this great and growing evil may be remedied, and that the diseases which arise from it may cease to prevail locally, or to increase generally.

There can be no doubt that the extensive sands and silts which encumber and disfigure the estuary of the Mawddach, could be made to serve a better purpose than causing floods above, and blinding with their sand-drifts people crossing the viaduct. Other rivers, such as the Tyne, the Clyde, and the Tees, have benefited by the works of the engineer, and it would be well if, throughout the country, his aid were invoked in removing what I cannot help calling a disgrace to the science of the nineteenth century.

The Tees was formerly, like the Mawddach and other rivers, a very irregular and wandering water-course, between Stockton and Middlesborough, and after passing that town it opened out into a wide, sandy estuary, about six miles long and three miles across at its widest part. Training walls and dredging were both used, and with a great amount of success.

The deepening of the channel of the *River Tyne* has produced a very beneficial *lowering of the flood-line* in the river, thereby preserving the adjacent *lands from inundation*—this we learn from Mr. Messent, in his work on "The River Tyne Improvement," 1882.

In the *River Clyde* dredging is constantly practised, and other works have been carried out; since which the tide falls 8 feet lower at Glasgow than it did before any works were begun, which not merely adds to the tidal capacity of the river, but also *prevents* the *fresh-water floods*, which formerly inundated the low-lying portions of Glasgow, whilst the total tonnage entered and cleared has increased from 1,757,000 tons in 1863, to 5,544,000 tons in 1883.

The harbour of Barmouth was once a busy scene with its ships and their imports; the *sands*, however, have taken the place of the ships, and the harbour is deserted—in fact the sands, the floods, and their ill-effects have all increased together, and the sooner this malign progress is arrested the better for the beauty of the locality and the health and wealth of the community.

On "Teneriffe as a Health Resort," by G. W. STRUTTELL.

OROTAVA, Teneriffe, now enjoys considerable reputation as a health resort for European invalids. It undoubtedly possesses a warmer and more equable climate than the Riviera, and a less humid climate than Madeira; yet there are drawbacks and disadvantages which in fairness ought not to be overlooked. My object is to record in brief terms my own experiences of Teneriffe from October, 1888, to May, 1890, so as to enable invalids in search of a health resort to judge whether the Fortunate Islands, as they are termed, are likely to be suitable for them or not.

Exaggerated statements have appeared in print with reference to the climate of Teneriffe. It has been termed a "rainless Paradise"; it has been asserted that "firing is unneeded," and that throughout the winter one can bathe at Orotava with as much pleasure as at Brighton in July. These experiences, I should imagine, are absolutely exceptional, and are calculated to mislead the reader. I myself was induced to visit Teneriffe for the benefit of my wife's health, on the strength of Mr. Ernest Hart's pamphlet, "A Winter Trip to the Fortunate Islands." I found that during Mr. Hart's visit the weather was unusually fine, and that the statements he makes, though unquestionably true, do not convey an altogether accurate idea of the general climatic conditions of Teneriffe.

There are various ways of reaching the Canary Islands, of which group Teneriffe is the centre. The sea passage may be shortened by taking the Spanish mail boat from Cadiz, but the Donald Currie steamers, which call at Lisbon are better boats, and do the distance of 750 miles in about 54 hours. Viâ Cadiz, including rail, the cost is £20, as against £22 viâ Lisbon. The Donald Currie steamers, however, only touch at Las Palmas, which entails transhipment. Undoubtedly the best way for those who can bear the sea voyage is to go by steamer from England. There are four excellent lines—the New Zealand Shipping Company, the Shaw, Savill and Albion Company, the British and African, and the Union. These vessels leave London (calling at Plymouth), Southampton, or Liverpool ten or twelve times a month. Invalids, I think, would do well to give the preference to the New Zealand or Shaw, Savill Company's boats, as they are admirably equipped for comfort, and perform the voyage from Plymouth in less than five days. A single first-class ticket by either line costs £14, and a return, available for six months, £25.

There is no difficulty in reaching Teneriffe. The trouble is to get away, as there is uncertainty as to when the return steamers call, and when they do, there may be no accommodation. As visitors begin to leave early in May, a passenger steamer might very well call at Orotava early in that month, and another early in June. Steamships prefer to call at Santa Cruz, which is 25 miles off, owing to the alleged bad anchorage at Orotava, but my experience is that from May to October that roadstead is safe enough.

After landing at Santa Cruz, I suggest Laguna as the first halting-place for the invalid. It is situated on a plateau about 1,800 feet above sea level, and possesses a comfortable hotel. At Santa Cruz itself, at Camachio's hotel, the sanitary and other arrangements are excellent. As, however, Santa Cruz is debilitating early in October, when invalids usually arrive, visitors do well, instead of hurrying on to Orotava, to make a stay at Laguna, which is only an hour and a half's drive. From December to March Santa Cruz has a charming climate, and is well sheltered from the north-east winds. What, however, Santa Cruz needs is hotel accommodation outside the limits of the busy town itself.

Passengers going from Santa Cruz to Laguna will find the roadway exceedingly good, though they must be prepared for much jolting and bumping when passing through the streets of the latter town; but this, I am told, will soon be a thing of the past, as there is a promise that before long the streets will be re-paved on modern principles. A word of caution by the way. The heat of Santa Cruz may be found oppressive on landing, but those who are going on to Laguna—the summer and autumn retreat of Orotava and Santa Cruz—will find it unadvisable to discard their warm clothing hastily.

Many of the English invalids at Orotava derive considerable benefit from a change to Laguna; but my wife derived greater benefit from her stay in Orotava from July till October than in any period of her visit. The great drawback to remaining in Orotava in the autumn is that invalids lose the services of Dr. George Perez, a graduate of London University, and his partner, Dr. Thurstan, an M.D. of Cambridge, the only other qualified English doctor there. Dr. Perez' patients are unanimous in his praise. The professional ability of Dr. Tomas Zerola, the resident medical man at the Villa, is universally acknowledged by his English patients.

From Laguna to Orotava is about four hours' drive, over a roadway highly creditable to Spanish engineering. The mountain scenery *en route* is striking, and the terrace system of

cultivation is seen to great advantage. From Matanza, where one stops for lunch, there is a good view of the Peak, which attains a height of 12,176 feet, rising directly from the sea level. The crater is about eight miles in diameter, and 7,000 feet above the sea, and from its centre rises the Peak itself, a further 5,200 feet.

The town of Orotava, or Puerto de la Cruz, is situated on a low peninsula about 60 feet above the sea. The first plateau, at an elevation of 380 feet, is most salubrious, very desirable for chest patients. Lower down it is enervating; higher up rather too cold. This first plateau offers a favourable position for the construction of small villa residences with pretty gardens, which by most visitors would be preferred to hotels. Such villas, however, should not be erected too near to cultivated areas or large reservoirs. The former are frequently manured with human excreta, and the latter give off unhealthy exhalations in the summer months.

After a further ascent of 720 feet, one reaches the base of the mountain proper, where stands the ancient town of La Villa Oratova. Though this altitude has proved beneficial in some cases, yet it is too frequently enveloped in cloud to render it a very desirable resort.

As to the Puerto itself, its streets are narrow, the houses high, and the free circulation of air is impeded. Nevertheless, typhoid fever is unknown. As to the climate generally, its equability seems to show that the island is not so dry as represented. The visitor must not be disappointed to find during the early part of his stay in the north of the island that there is a fair quantity of rain; but, the ground being porous, the atmosphere is not rendered so humid as the amount of rainfall would suggest. Outdoor recreation is, however, frequently interfered with. Then, as to mean temperature. On that point visitors may be easily deceived. In England 62° would be regarded as sufficiently warm to enable fires to be dispensed with and lighter apparel to be partially assumed. In a warm climate, however, 62° is sufficiently cold to justify the invalid wearing a sealskin out of doors, and keeping a fire going indoors. This seems to me to show that without some knowledge of the locality, one may be working in the dark, even in the presence of meteorological records.

But, though Teneriffe has its faults, I think that on the whole it may be pronounced a most desirable health resort. I myself intend taking my wife back there in October, 1890, in preference to any other place; so that, though I do not hesitate to speak frankly about its drawbacks, I have a high opinion of Teneriffe as a sanatorium. Its charm is that, owing to its

mountainous character and geographical position, there is a great variety of climate.

Clearly, therefore, there is a probability of the invalid obtaining relief, though the first place he visits may not suit him. I have known Santa Cruz to confer benefit where other places had failed; Laguna to suit complaints which were not favourably affected at lower elevations; and Orotava and Icod to benefit those who went there as a last resource. In the near future, it is possible that a still larger variety of climate will be accessible to invalids, for Villaflor and Guimar, on the south side of the island, are spoken of; the former as the "first mountain station in the universe," and the latter as possessing an exceptionally dry and sunny climate.

I think that the physical advantages of Teneriffe are unique. Within the comparatively small area of 900 square miles, it has altitudes ranging from a few feet to 8,000 feet above the sea level. It has a northern and a southern aspect, rendered distinct by the great Cordillera running east and west. The north aspect is favoured by the north-east trade winds, the south by warm trans-African winds, cooled in their progress across the narrow strip of sea.

To give some meteorological details taken at Orotava, the mean variation of temperature between morning and night, *i.e.*, 9 a.m. and 9 p.m., is not more than 2°·8. The average temperature in spring, summer, autumn, and winter is respectively 64°, 71°, 69°, 60°; while the lowest temperature for the same seasons in the shade is 54°·9, 51°·8, 50°, and 49°·1. The mean minimum is 59°·3, 55°·4, 53°·0, 52°·7. The extreme difference between winter and summer is not more than 14°, whereas at Nice it is 30°, and in Algiers 24°. The total annual rainfall is 15·35 inches, falling on eighty-five days, and the average monthly sunshine—136 hours—distributed as follows: November to January, 110 hours; February to April, 140 hours; May to July, 132 hours; and August to October, 160 hours. Storms of thunder and lightning are rare.

The drawbacks with regard to life in Teneriffe are principally in reference to accommodation and food. The majority of the houses are of the Moorish type, built without fireplaces, and solely with a view to coolness. Stoves are absolutely necessary, and so are curtains and other appliances for keeping out draughts. As regards servants, warning is not required on either side, therefore it is advisable to study the idiosyncracies of your domestics, or they may leave you in the lurch. A knowledge of the language is very desirable, but even with this aid you cannot expect to reform a Spanish servant, who has remarkably conservative instincts. As a rule they are very

honest; but they are desperate love-makers, and one sometimes gets tired of hearing the wretched twanging of the troubadour beneath the bedroom window at night.

As to society in Teneriffe, after an experience of twenty-five years spent in various parts of the world, I have never known a happier community than that of Orotava. The relations between the English and Spanish gentry are most cordial, though the latter believe that every new arrival from Europe adds to their difficulties by helping to raise the price of food.

Let me add a word on the subject of social amusements. They are arranged, no doubt, with a commendable desire to render Orotava attractive, but some invalids have been drawn into merriment which they could not resist, and have returned all the worse for a sojourn in what should have been a place of perfect rest and quiet. If balls and bazaars must go on, they should be held somewhere else than in the hotels.

Orotava greatly needs a public market and improved food supplies. The butchers are generally ignorant of their business and often present meat of doubtful quality in a most repulsive condition.

The English residents should club together and purchase, and stall-feed, sheep for their own consumption—an alternative resorted to in different parts of India where the same inconvenience sometimes occurs. Milk, bread, butter, fowls, ducks and turkeys, are cheap and plentiful. There is a difficulty, however, in obtaining groceries, meat essences, and invalids' food. This is due to the fact that visitors are in the habit of getting supplies from the Stores in England, with the result that shopkeepers in Teneriffe are not encouraged to keep large and varied stocks on hand. For my part, I believe little is saved by these direct importations, while much general inconvenience results.

A word or two as to water supply. At the Port of Orotava it is of very good quality, and enteric fever has never been known. That of La Villa Orotava is less excellent, and should in every case be filtered. There is no doubt that the absence of a proper system of sanitation throughout the island would be a much more serious matter but for the absorbent nature of the soil, the sparsity of the population—towns and villages not being overcrowded—and the open nature of the country.

There is one subject directly bearing on the comfort of invalid visitors, and that is the absence of professional nurses at Orotava. There is a scheme now on foot for supplying the deficiency, but it is felt that, to ensure stability for a fixed period, a sum of not less than £500 must be raised, though the institution, it is hoped, will eventually be self-supporting.

The proposal is to secure the services of two lady Sisters of Charity of the English Branch of St. Vincent de Paul. There are, however, various difficulties to be surmounted. The provision of nurses is exceedingly desirable for those invalids who are unable to travel with a private nurse, or, indeed, to pay for the services of a nurse when nursing aid may be much needed. Contributions to this fund may be paid into the London and County Bank, to the credit of the treasurer, the Rev. T. Gifford Nash, Orotava Nursing Fund.

With respect to wearing apparel, it is advisable to take to Orotava just the same outfit as if going on a twelve months' visit to any part of England. Sanitary woollen underclothing, sheets, and pillows are desirable. A sealskin coat or an overcoat will be found a comfort at one time; at another, summer garments will be essential. There are very good tailors and dressmakers in the island, and good boots are procurable at ridiculously low prices.

Before concluding this brief paper, let me add that it is impossible, as Sir Morell Mackenzie well points out, to say with certainty whether this or that particular climate will suit a particular case, and that to phthisical patients the benefit of a change of climate will be greatest if it renders an out-of-door life possible. With an island possessing such climatic conditions as Teneriffe, varying, as they will be found to do, according as the visitor may select his place of residence, it is clear that discrimination is needed if the invalid desires to return home benefited by the change. I have endeavoured to point out that Teneriffe does not altogether merit the roseate colours in which it sometimes has been painted; but I have also endeavoured to do justice to its admirable situation, its exceptional climate, and its possibilities as a health resort.

Mr. Baldwin Latham (London) considered that papers of this kind were very valuable, for they enabled the Institute to keep a record of the climatic conditions of celebrated health resorts.

Mr. Symons (London) quite agreed in this view.

Mr. White (London) was quite aware that dancing was one of the most healthy amusements, if it were properly carried out, and The Sanitary Institute ought, he thought, to do its best for its promotion.

Mr. Struttell (Brighton) said that with regard to dancing in Teneriffe, the difficulty was that the hotels were too small for this amusement, and when dances were given invalids could not get to sleep. Besides, there were many invalids who, if dances were given, would enter into them despite the fact that they would be much better if they were taking rest.

TABLE REFERRED TO IN PAPER ON THE CLIMATE OF BRIGHTON (p. 228).

Number of Days on which Mist, Fog, or Haze were observed at Brighton.

	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888 *	Total 1868—1887
January	4	4	2	2	3	6	6	3	3	3	3	2	3	3	5	1	3	2	3	5	9	66
February	6	3	2	5	—	7	2	4	4	2	7	2	2	3	3	3	1	6	—	2	1	64
March	6	5	3	4	4	3	4	4	1	1	—	2	5	2	5	1	3	4	4	1	2	62
April	4	6	1	1	3	2	2	—	6	2	4	1	2	5	1	—	—	1	—	—	2	41
May	2	3	1	—	1	2	3	2	1	—	2	1	—	2	—	—	—	1	2	1	2	24
June	—	4	1	—	—	5	—	2	4	1	—	2	—	1	—	2	—	1	1	—	1	24
July	—	2	—	2	—	3	1	1	7	1	1	2	—	—	—	—	—	—	—	2	1	22
August	6	—	1	3	1	1	1	1	—	—	—	1	—	—	—	—	—	—	—	—	4	15
September	—	2	—	—	—	1	3	1	—	—	1	—	1	—	2	1	—	—	1	—	—	13
October	2	4	1	6	3	4	—	—	1	4	1	2	—	2	3	4	1	1	4	2	—	45
November	3	3	4	7	7	2	3	2	1	1	2	2	3	3	—	2	1	7	4	1	—	58
December	5	4	1	4	—	6	2	2	2	—	—	2	2	5	8	8	—	5	4	2	—	62
TOTAL	38	40	17	34	22	42	27	22	30	15	21	19	18	26	27	22	9	28	23	16	...	496

* Up to end of September.

CONFERENCE OF MEDICAL OFFICERS OF HEALTH.

THE fourth Conference of Medical Officers of Health, arranged by the Institute, was held in connection with the Brighton Congress.

There was a good attendance of Medical Officers from the principal provincial centres.

The chair was taken by Dr. A. Newsholme, Medical Officer of Health for Brighton, President of the Conference.

Papers on the following subjects were read and discussed:—

"The Study of Hygiene, in the Elementary Schools," by A. Newsholme, M.D."

"The Etiology of Diphtheria," by W. N. Thursfield, M.D.

"Uniformity of the Reports of the Medical Offiers of Health," by A. Wynter Blyth, M.R.C.S.

A full report of the subjects discussed is given in "Public Health" for September, 1890, page 134, and October, 1890, page 163; and, as much of the matter was of technical interest, it was thought unnecessary to reprint it in the Transactions of The Sanitary Institute.

CONFERENCE OF INSPECTORS OF NUISANCES.

ADDRESS BY DR. A. CARPENTER,

PRESIDENT OE THE CONFERENCE.

ABSTRACT.

Dr. Carpenter said that he was glad that they were following in the footsteps of the Medical Officers of Health, who had met in Conference on the previous day. The founding of the Institute was the thought of men who had been instrumental in bringing to the notice of the State the wants of sanitary law, the result of which was the passing of the Act of 1848. It was his privilege to reside in a town that was in the first list of those that took advantage of that Act. The Local Board made bye-laws. After a short time they discovered that these bye-laws were dead letters, and then a Sanitary Committee was appointed, of which he had the honour to be Chairman. They made a report, and the local authority determined, in accordance with the recommendations contained in that report, to appoint inspectors to see that the bye-laws were carried out. Then came the battle. They had to face the opposition of those who objected to the appointment of Sanitary Inspectors. Owners of small houses and others felt that Sanitary Inspectors would be prying into their private affairs, and causing them much trouble; but after a time the unpopularity became dormant, and the inspectors were appointed. Then there was the disadvantage of the appointment of incompetent persons as inspectors.

He then explained that such methods of administration in various localities led to the establishment of the Sanitary Institute, through which properly qualified men were able to obtain certificates, showing that they were capable of doing the work which they undertook. The work done by the Institute in this way was of great value to local authorities when they were about to appoint Sanitary Inspectors, and the Institute had in consequence of that and similar actions commended itself to the public generally. Public opinion had now materially advanced in favour of sanitation, and the position of Sanitary Inspectors had greatly improved. Some people were inclined to think that the office of Sanitary Inspector or of Inspector of Nuisances was a new office, but it was no such thing. It was one of the offices in connection with hygiene that had been formed in very early times. They had only to go back to the pages of Holy Writ to prove it. Let them read Leviticus, and study the laws laid down by Moses, and they would see

that the Sanitary Inspector he appointed was one of the most important men in the state. When the sewage of a house had produced disease, the occupier was to go to the priest, who explained things, and he became the Inspector of Nuisances within the camp, or, as it was afterwards, within the cities of Israel. Therefore, they had to go to the highest authority for the foundation of their office, and the importance of their social position in connection with this office was very manifest from what was in the mind of Moses. The formation of infectious hospitals was really inaugurated by him. They would find that he appointed that infectious diseases which were there classed together under the head of leprosy should be treated by isolation without the camp. That would not be without shelter, and they might assume that hospitals were erected for their protection.

Passing on, he said that at the present time there was not a town in the kingdom where the sanitary authority was doing its duty which had not a hospital in which it could isolate cases of infectious disease as soon as they were brought to its notice.

Touching upon the manner in which the work of Sanitary Inspectors should be done, he said that there were two classes of officers. Some went with the threat of legal proceedings in their mouth, and did not attempt to explain why certain work had to be done, and if they acted in this way they set up the backs of the people, and did not get the work carried out to the satisfaction of the Authority. It was far better that people should be taught by the Sanitary Inspectors the reasons why different work had to be done, and be persuaded to carry out the principles necessary for the removal of nuisances, and so diminish the chances which lead to the spread of infectious disease. It was far better for the people to do the work willingly, and look upon the Sanitary Inspector as their friend, than as a prying, intolerant autocrat, who would force down their throats the principles of sanitation whether they liked it or not.

Referring to the pay of Sanitary Officers, he agreed that every labourer was worthy of his hire. A paper was sent to him when he was away from home with regard to compensation and mutual assurance, he hoped that the gentleman would accept his apology for omitting to cause it to be placed on the agenda. If there was time when the other papers had been disposed of it would be read. He congratulated those present on being invited by the Institute, and the Institute on inviting the Inspectors to meet in conference in the important and healthy Borough of Brighton, which he said was almost the healthiest town in the kingdom. The invite extended by the town to the

Institute reflected great credit on the town itself, the Institute and Inspectors being thought worthy of the presence of the Mayor at their meetings reflected credit upon them. Brighton was healthy, but he claimed that if they took a decade of ten years, his town, viz., Croydon, had beaten it.

Passing on, he said that he had thought it necessary in the town of Brighton to draw attention to the waste of material in regard to sewage. It was the only serious sanitary fault he found. They had magnificent waterworks and constant water supply, and the fact that the streets and poorer classes of houses were well looked after by the authorities was proved by the healthy condition of those classes, and the absence of mischievous disease from their midst. He hoped that the time was not far distant when the Legislature would prevent the washing away into the sea of that which was absolutely necessary from a national point of view for the feeding of the people. If that material were placed on the Downs at the north of Brighton the crops would be ten times more abundant than at the present time, and the chances of destroying the sea-shore of Brighton as a bathing place altogether removed. In connection with the milk-supply this was most important. He looked upon it as a part of the duties of local authorities not only to provide for the grown-up, but to see that the younger children were provided with material which would help to sustain them in a healthy state of existence. Where a district did not provide a sufficient amount of milk for the people who inhabited it, and it had to be obtained at prices which were prohibitive to the poorer classes, there was something wrong. If the sewage was put on the Downs, as he had said, the milk-supply from this particular land could be ten or twenty times as much as it was at the present. The expenditure of capital upon sanitary works was never lost, and though it might not obtain an absolute reduction of the rates it reduced the death rate, and the utilization of sewage in the way he had stated would bring food down to a fair and average rate. He again thanked the Corporation of Brighton for inviting them to that beautiful town, and said that all would, when they returned, be able to say that the Congress at Brighton had been a great success.

The Mayor of Brighton considered that Dr. Carpenter had sketched to the Inspectors much that was beyond what was necessary for their position: he had shadowed forth a list of first principles. Now they had nothing to do with first principles, they were engaged to carry out the work after the first principles had been sketched out; for it was not possible for men of ordinary calibre to grapple

with the great questions of sanitation. As to the disposal of sewage, they all knew that it should be returned to the land; but when they were surrounded by the ratepayers they had to do the best thing for the smallest amount of money, and he considered that the Brighton Corporation had done the best under the circumstances. Addressing himself to the duties of the Inspectors, he said he thought discretion was very necessary, and that they should carry out their duties as nicely and kindly as possible. They must not only be discreet and civil, but it was necessary that a man should have a fairly good education before he took office. He thought an Inspector should have an elementary knowledge of diseases, and a knowledge of building construction was essential as well as a little knowledge of chemistry. He contended that it should be the occupier of every house who should be worried and terrified into keeping the drains in good order, and not the owner, and that liberty should be given to an owner, if he saw that an alteration could be done in a certain way, and that if it would be half the cost, to carry it out in that way. In conclusion, he proposed a vote of thanks to Dr. Carpenter for his address, and expressed the hope that the Chairman might long be spared to do his work as he had done hitherto.

Dr. A. Newsholme seconded. He was glad to find that the examinations of the Sanitary Institute had been so highly spoken of, although he could not help thinking that the examinations should be supplemented by a little building construction. He also thought that the passing of the examination in hygiene at South Kensington was a very great thing.

Dr. Carpenter acknowledged the compliment paid him. He knew that the fifty years of work in which he had been engaged could not continue much longer. Still, he was glad to do what he could in promulgating sanitary science.

"*The Education, Examination of, and Legislation for, Sanitary Inspectors.*" By A. E. Adams, Sanitary Inspector, Wood Green.

ABSTRACT.

The author considered that it was largely through the Sanitary Institute that Sanitary Inspectors were better educated than they were twenty-five years ago.

He agreed with the Association of Public Sanitary Inspectors that Inspectors should have a knowledge of building construction, but considered that to qualify to pass the 1st Class, *advanced*, of the Science and Art Department, would occupy too much time, and was not necessary.

He considered the Sanitary Institute right in not having *Competitive* examinations; and Sanitary Inspectors should feel

that they owed a debt of gratitude to the Sanitary Institute for the way in which they had grappled with the question of the examinations. In nearly all advertisements for Sanitary Inspectors the Candidates were required to hold the Certificate of the Sanitary Institute. He believed the feeling amongst Sanitary Inspectors was that the examinations were not sufficiently practical ; but he considered that the standard at present required was quite high enough if the questions at the *vivâ voce* examination were more searching, and models added to thoroughly test the knowledge of the Candidates.

He suggested that the Council of the Sanitary Institute should invite a dozen or two Sanitary Inspectors to meet them to discuss the question of the examinations, but he was strongly opposed to any Sanitary Inspector being put on the Board of Examiners.

He thought that Sanitary Inspectors should combine to obtain the appointment of a Minister of Sanitation, but he did not advocate Trade Unionism, but an amalgamation to obtain recognition as Public Servants, and that the Laws of Public Health might be made more stringent and complete.

"*The Position that Inspectors should take with regard to the General Public.*" By JOSEPH CORBEN, Chief Sanitary Inspector, Southampton.

ABSTRACT.

The author observed that it was matter for congratulation that the Sanitary Institute had inaugurated this General Conference of Sanitary Inspectors.

Speaking on the subject of his paper, he said that by the general public should be understood the ratepayers, some of whom were the owners of small tenements not in a first-class sanitary state, and were ready to impress on the Inspector the advisability of making friends of them.

An Inspector, when requiring improvements, should act with prudence, and should endeavour to educate the public, so as rather to persuade, than to appear to compel, an owner of property to make any necessary improvements.

The author suggested that sometimes the Inspector is impeded in his duties by the Medical Officer of Health either being antiquated in his notions or twenty years in advance of the times.

He considered that the yearly appointment of the Inspector tends to make him less independent and more susceptible to be

influenced in the performance of his duties than he would be if his appointment were permanent.

Mr. W. Wilkinson proposed the following resolutions :—

"That in the opinion of this meeting the administration of Sanitary law would be greatly improved by the following amendments thereof, and the Council of the Sanitary Institute are hereby requested to press upon the Legislature—

"1. That a Government Department of Health be established, and presided over by a Cabinet Minister, having supreme control over all matters connected with the Public Health.

"2. That the officers now variously named Sanitary Inspectors, and Inspectors of Nuisances, be designated Sanitary Inspectors.

"3. That Candidates for the position of Sanitary Inspectors be required to possess a general knowledge of the building trades, and a Certificate in Sanitary Science.

"4. That all Inspectors be elected to a permanent tenure of office, and only dismissable for misconduct or proved incompetence, with right of appeal to the Local Government Board or Department of Health.

"5. That Sanitary Inspectors be required to inspect their districts for the detection of nuisances, and to serve notices for the abatement thereof, all such notices to be as valid, if confirmed by the Local Authority, as if served by the Authority's Order.

"6. That the duties of Sanitary Inspectors be clearly defined.

"7. That in all appointments requiring an officer's whole time, an adequate minimum salary be prescribed.

"8. That steps should be taken to form a fund for granting superannuation to Inspectors."

Mr. Ernest Day, F.R.I.B.A. (Worcester), considered that if an Inspector had tact he would succeed with the multifarious duties he was called upon to perform. That an Inspector should possess a practical knowledge of the building trade was, to his mind, of the utmost importance. He was delighted to see that there had been a great improvement in preventing jerry building, and some of these builders had now very great difficulty in evading the bye-laws.

Mr. Washington Lyon held that the appointments of Medical Officers of Health and of Sanitary Inspectors were the most important of any in connection with Local Boards. Regretting the remark made by the Mayor of Brighton to the contrary, he thought it most important that Inspectors of Nuisances should have a thorough knowledge of first principles. If they were in possession of this knowledge, the clever men upon the Sanitary Committee would appreciate it, and these clever men, before whom they had to go, would lead the ignorant ones, so that the Sanitary Officers, if well qualified, would really be the leaders.

Mr. W. Wilkinson, having read his resolutions again, supported his

claim that all Inspectors should be designated "Sanitary Inspectors" by urging that they were asking for nothing new, and that in many cases the same men had to inspect new buildings as well as act as Inspectors of Nuisances. It was so in his own case. He discountenanced the practice of taking a man from the outside and constituting him a Head-Inspector, and urged that every man should first act as an assistant. There could be no objection to theirs being a permanent appointment, and he held that Inspectors should have the power to serve notices at once where nuisances were discovered, inasmuch as the local authorities often only met once a fortnight or once a month, and great harm might be done by delay. The Public Health Act did not explain what their duties were, and it was most necessary that they should know exactly what they were expected to do. Upon the question of salaries, in some places it was the hardest possible work for a man to live and present a decent appearance upon the salary he received. In certain places the authorities did not pay for the work to be done, but sought to satisfy the Legislature at the lowest possible cost. He also claimed pensions for those who had to endanger their lives to save others.

"*The Position that Inspectors should take with regard to the General Public.*" By THOMAS GEORGE DEE, Sanitary Inspector, Westminster.

ABSTRACT.

The author pointed out the importance of cleanliness in the prevention of disease, and he considered that some knowledge of the laws which govern Sanitary Science or preventive medicine was necessary on the part of the Sanitary Inspector.

The Inspector should take the position of the practical adviser of the public upon the details of works of sanitation, and he should possess sufficient legal knowledge to enable him to form a judicial opinion upon all statements and facts.

The conclusion arrived at by the author was that a Sanitary Inspector should be "something of a clergyman, a doctor, and a judge."

"*On the general duties, responsibilities, and status of Sanitary Inspectors; applicable to those Officers appointed by virtue of, and working under, the Public Health Act,* 1875; *and to their position in comparison with other Public Officials.*" By GEORGE STEERS, Sanitary Inspector, Bedford.

ABSTRACT.

The author pointed out that, inasmuch as the Sanitary Inspector is required by law, in a notice to abate a nuisance, to

give full particulars of work required to be done, he ought to have a thorough practical knowledge; and he considered that Inspectors should have power to serve a legal notice for the abatement of a nuisance without having first received the sanction of the Local Authority to do so.

Looking at the nature of the duties that a Sanitary Inspector has to perform, he considered that his appointment should be permanent; and, further, that the status and position of a Sanitary Inspector does not compare favourably with that of many other public officers.

"*The Position that Inspectors should take with regard to the General Public.*" By J. Hicks Beel, Sanitary Inspector, Gosport.

ABSTRACT.

The author considered that in order to obtain duly qualified men as Sanitary Inspectors they should be better remunerated. Thanks to the Sanitary Institute, the importance of the duties of the Sanitary Inspector is becoming recognized.

Every Sanitary Inspector should have had three years' experience as an Assistant Inspector. He should understand the advantages of various sanitary appliances, and to qualify him for the Inspection of builders and plumbers' work, he should hold a Certificate of competency in Building construction, which should be obtained before the Certificate of the Sanitary Institute is granted.

The author's experience was that the poorer residents receive the Sanitary Inspector gladly, but that the owners of property hinder him in the performance of his duties. He was of opinion that the Chief Inspector should have power to give legal notice for the removal of nuisances.

He suggested that a Union of Sanitary Inspectors should be formed under the auspices of the Sanitary Institute, composed of Sanitary Inspectors who have held that office for upwards of three years; the objects of the Union being the discussion of matters affecting their interests, to watch the working of the laws affecting County Councils and Local Boards, and to promote such measures as may from time to time be deemed advisable.

In conclusion, the author suggested that the meeting should adopt resolutions approving of such a Union, with the special object of securing a settlement of the question of superannuation.

The Chairman announced himself in favour of provision for the after years of Inspectors, but thought that it must be met by the Inspectors themselves contributing out of their salaries, by the Local Authorities paying an amount during the good behaviour of their officers into the fund at command of the Local Government Board, and by the Local Government Board supplementing it by a grant from the Imperial Exchequer to enable the officials to retire comfortably after a certain number of years.

Mr. J. Osborne (St. Pancras) had been much struck by the consensus of opinion which had run through the papers. They found that the status of the Inspector wanted considerable improvement, and they were agreed as to the way in which the improvement should take place. He had had considerable experience—over sixteen years—as a Sanitary Inspector, and he must say that the men he had come in contact with were never open to any bribery. The duties of Inspectors of Nuisances were certainly very varied, but in the President's address he thought that that gentleman travelled a little beyond the duties and even the powers of a Sanitary Inspector. At the present time they had nothing whatever to do with the construction of the drainage, or the sanitary condition, of a house until it was occupied. In his opinion it was one of the great curses of their work that the construction of the drainage and sanitation in many districts at the present day was left to take care of itself. The jerry-builder employed a navvy, and he was the sanitary engineer, throwing in his drain and getting it out of sight as soon as possible. The British workman was the best in the world if his work could be seen, but if his work could not be seen he was certainly the worst. The construction of drains in new properties should be under the supervision of a practical sanitary officer, who should be responsible for their proper construction and be in a position to give a Certificate. With respect to the knowledge that was necessary for an Inspector previous to holding an appointment, he greatly believed in the officer being thoroughly conversant with the whole of the different sections of the building trade; unless, too, Inspectors had tenure of office made secure, there was a tendency to make them shirk their duties.

The Chairman moved a vote of thanks to the writers and readers of the papers. He gave expresssion to the hope that there would be an alliance of Sanitary Inspectors throughout the kingdom.

Mr. Washington Lyon seconded. He thought that the day was not far distant when the Sanitary Inspector would be looked upon as almost second to the Doctor.

Mr. Steers having replied, an acknowledgment of the valuable services of the Secretary (Mr. A. Perry) was made by the Chairman, and duly replied to.

THE SANITARY ASPECTS OF ELECTRIC LIGHTING.

LECTURE TO THE CONGRESS.

By W. H. PREECE, F.R.S., M.Inst.C.E., &c.
Electrician to the British Post Office.

The chief tendency of modern legislation in our British Parliament is to improve the environments of the human frame, so that we may live, and move, and have our being with greater health to the individual, and greater prosperity to the nation. The cleanliness of dwellings, the drainage of towns, the removal of filth, the suppression of nuisance, have not only been specified but the inspection of the means to effect these objects and of their results are defined and insisted upon by Acts of Parliament. People often speak disrespectfully of our grandmotherly Government, but at least in this region of domestic legislation, the control it has exercised over the food we eat, the water we drink, the air we breathe, is of a true parental order, and deserves our unreserved admiration and respect. The Home Office and the Local Government Board act the part of a wise and economic head of the house to the nation, while each community has its own Local Board or Authority to carry out hygienic provisions, to enforce sanitary principles, to prevent infection, to stamp out disease, to sweeten labour, and to prolong life.

I contemplated at one time submitting an historical summary of these features of sanitary legislation during the present generation, but not only would the task be very onerous, but it would be so lengthy that I should have very little time left to discuss the question set before me—the Sanitary aspect of Electric Lighting.

The propositions that I propose to submit and to demonstrate to you are these:—

1. That electricity and light being analogous forms of

energy, the former is naturally the proper source of artificial illumination.

2. That all other sources of artificial illumination being dependent on the absorption of oxygen, and resulting in the vitiation of air are injurious to health.

3. That the same authority which regulates the sanitation of our dwellings and the supply of our food, should also control the purity of the air we breathe, and of the light we work by.

Light, however it be produced artificially, is simply the equivalent of work that has been done elsewhere. Whether it be by the combustion of tallow or oil, by the burning of coal or of gas, by the glowing of a fine wire, or the formation of the brilliant arc, energy has been expended somewhere, to be transferred and reproduced in some other place in the form of light. The great principle of the conservation of energy teaches us that the amount of energy in the universe is a fixed quantity, that it can be neither created nor destroyed, that it can only be transferred, and that any expenditure of energy —work done—anywhere is the equivalent of energy utilized somewhere else. The rate at which this energy is expended is called *power*, and the amount of power which we foolishly call a *horse-power*, and which we roughly imagine to be equivalent to the power exerted by a horse in drawing a load along a road, is competent to produce an amount of light which is very simply measured. Our standard of light is the light given by a No. 6 sperm candle, burning 120 grains per hour. Now the energy of one horse-power constantly expended will give by the aid of

Tallow	the light of	6	candles.
Sperm	„	8·7	„
Oil	„	9	„
Gas	„	13	„
Electric current—Glow	„	248	„
„ Arc	„	1492	„

The results to the air of these different modes of producing artificial illumination are well shown by the following Table :—

Products of Combustion in developing 100 *candles per hour.*

Illuminant.	Quantity Consumed.	Carbonic Acid Produced.	Water Vapour.	Heat.
	lbs.	Cub. ft.	lbs.	Calories.
Tallow	2·2	51·2	2·3	9,700
Sperm	1·7	41·3	2·0	7,960
Oil	1·3	33·6	1·8	7,200
Gas	56 Cub. ft.	40·3	2·5	12,150
Electricity	(Coal) 2·2 lbs.	0	0	257

Thus we see how very much more efficient electricity is than any other agent for the production of light.

The tendency of the teaching of the present day, is to show that the transmission of light waves and of electrical undulations, is of the same character and at the same speed. Clerk Maxwell by theory, and Hertz by experiment, have placed this beyond doubt. A current of electricity passing through a fine filament, first raises its temperature, and then as the current is increased in strength, it glows brighter and brighter until finally it is disintegrated and dissipated with great brilliance, and the light disappears. There has been no chemical consumption of material. The passage of the current has resulted in light, and light seems to have been the natural sequence of the flow of electricity. Energy has however been developed somewhere. There is a boiler for the production of steam, an engine for the application of power, a dynamo for the formation of electric current.

Gas has to be extracted from coal, purified in gas works, distributed through pipes, and chemically combined with the oxygen of the air in jets or burners.

The simple candle, however, is its own gas works. We simply apply a match and the flame itself becomes boiler, engine, and light emitter combined.

In all cases, therefore, we have to consider—

(*a*) The source of energy.
(*b*) The distribution of energy.
(*c*) The utilization of energy as light.

The sources of energy at our disposal are—

Wind.
Water.
Coal (steam).
Gas.
Mineral oil.

The inconstancy of the wind in our climate renders it inapplicable for the steady and constant supply of power required for artificial illumination.

Water, on the other hand, is an unfailing source of power in some countries, but the quantity required to produce even small effects is opposed to its use anywhere but in mountainous or hilly districts where it is abundant. It requires a quarter of a ton of water falling one foot *per second* to produce one horse power, or falling ten feet to produce ten horse power. If we wish to maintain ten ordinary electric glow lamps alight for five hours with a fall of ten feet we should require 100 tons of water per hour, or 500 tons altogether.

At Keswick, in Cumberland, a central station has been established, which is worked by a fall of twenty feet of the water of the river Greta, generating fifty horse-power by means of a turbine. At Portrush, in Ireland, a fall of twenty-six feet generates currents that work a tramway to the Giant's Causeway. Many private houses in Scotland are so lighted.

There are innumerable places in the United Kingdom where this power is being allowed to run to waste. The non-utilization is due probably to ignorance, and ignorance as much as indifference is the great obstruction which all new industries have to overcome, even when practicability and economy are almost self-evident.

The power of running streams and of the tides is used in some countries for grinding corn, but the power utilizable is small, and no practical means have yet been introduced to employ them for small installations of electric lighting, though busy minds are actively engaged on this neglected field.

Steam and therefore coal becomes in all comparatively flat countries the principal source of power, while for small installations, gas and mineral oil are extremely convenient cleanly and economical suppliers of energy. Indeed, gas as a source of heat is coming more and more into use, and if a cheaper form of gas, such as water-gas were distributed for fuel purposes—as it probably will be in the future—it would solve the difficulty of the transit of coal, and prevent the possibility of that nuisance, the formation of smoke in the midst of shops and dwellings.

The power that is thus expended is employed in developing electrical energy. Motion is imparted to coils of copper wire in a field of magnetism, and a certain resistance has to be overcome when the lines of force in this field are cut by the wire; the energy of motion is absorbed, it takes the form of electricity, and as an electric current it can be transmitted to a distance, and there utilized. The amount of energy which is found in the form of currents is that delivered by the belt of the engine to the dynamo, less a small amount wasted in friction and in heat in the metal of the dynamo; but this is so small that it is a common thing now to obtain dynamos with an efficiency of 94 per cent. that is, 6 per cent., only of the power applied to it is lost as heat in the dynamo itself.

If a child has a skipping rope made of copper wire and, with its face turned due North or South, it skipped, the rope would cut the lines of magnetic force of the earth in the proper direction, the rope would experience resistance, energy would be absorbed by the rope, and electric currents would be developed from hand to hand of the child. The child thus becomes an animated dynamo. The lines of force of

the earth flowing North and South are cut twice in each revolution of the skipping rope, but alternately in opposite directions. Hence the currents generated are alternately flowing in opposite directions, and the child becomes an alternate current dynamo. It is a very simple thing to straighten these currents and to make them flow continuously in the same direction, and to convert these alternate effects into continuous currents flowing in the same direction.

Now, all electric currents require an electro-motive force, or a difference of electric pressure to drive them through the resistance of metallic conductors, in the same way that water and gas require pressure to drive them through pipes. This electro-motive force in the case of the skipping-rope is very minute, because the intensity of the earth's magnetic field is very small (it is only $\frac{1}{20000}$th of the field of an ordinary dynamo), the motion of the rope is comparatively slow, and there is only one cutting conductor. If we increase the number of conductors, their speed, and the strength of the field, we can magnify the electric pressure to any amount.

All new ideas require new names to indicate them, and if they are new quantities capable of measurement, they require new units to compare them with numerically. Difference of electric pressure is called voltage, and the unit of comparison is a *volt.* The skipping rope develops only a very small fraction, about $\frac{1}{4000}$th of a volt. There are now dynamos at Deptford which will generate 10,000 volts, and a flash of lightning is the result of perhaps millions of volts. The human frame is very sensitive to voltage, 50 volts is scarcely perceptible, 100 volts give a distinct though slight shock, 500 volts are painful, and 1,000 volts might probably under certain circumstances kill a man, 10,000 volts if effective through the whole frame would certainly destroy life. We have recently read of a deplorable attempt in the United States to utilize this power for the execution of criminals, an attempt surrounded with sickening horrors, the result of the ignorance that exists at present as to the effects of electricity on the human frame.

The unit of electric current by which measurements are made is called an *ampere.* If an ampere be circulated around a bar or ring of iron, it will magnetize it with a definite amount of magnetism dependent on its dimensions and quality.

If it be transmitted through a bath of nitrate of silver, it will deposit four grammes of silver per hour. If it be driven through a fine filament of carbonized cotton six inches long, such as Edison and Swan use for their glow lamps, by an electromotive force of 100 volts, it will develop a brilliant light of 32-candle power.

The actual energy conveyed by the current is measured by the product of the volts and amperes, and this measures the rate at which energy is being transmitted or expended. The unit of measurement is called *the watt*, which is a much more scientific and accurate unit of power than the absurd horse power that has become so rooted among our engineers. A man in pumping expends about 50 watts; in rowing a race he expends about a 100; in running rapidly up-stairs he expends 500 watts for a few seconds; a horse drawing a load on a level road expends about 500 watts. The so-called horse power is 746 watts. An ordinary arc lamp consumes 500 watts, and an electric tramcar going at seven miles an hour on an average tramway, requires a mean power of about 3000 watts.

Electrical energy is measured and paid for in 1000 watts or in *kilowatts* delivered per hour. A kilowatt-hour is called the Board of Trade unit of electrical energy, and it is defined in all Provisional Orders confirmed by Act of Parliament, thus:

"The expression 'unit' shall mean the energy contained in a current of one thousand amperes flowing under an electromotive force of one volt during one hour."

This Board of Trade unit has not yet received a name. I have proposed to call it a *Bot*, from the initial letters of the Board of Trade, but there is generally a very strong aversion to a new name, however much it may be wanted, and we have during the past few years had a plethora of new names in electrical science.

One Board of Trade unit will keep an ordinary 10-candle power glow lamp alight for 30 hours, or it will keep 30 of such lamps alight for one hour. In Newcastle this energy costs 4½d., in Liverpool 6d., in London 7¼d., and in most other places 8d. Taking the cost at 6d., a 10-candle power glow lamp would cost one-fifth of a penny per hour, which is the cost of a 5-feet gas burner at 3s. 4d. per 1000 cubic feet. There is thus very little difference between the price of gas and that of electricity.

The output of a dynamo is measured in watts, and, as the number of watts in ordinary dynamos is necessarily numerous, the *kilowatt*, or 1000 watts, is the unit employed. Thus, a dynamo of 100 kilowatts developes energy equivalent to 134 horse power, and as, for ordinary purposes, the ratio of the power utilized as electric current to the power indicated in the cylinders of the engine may be taken at 80 °/₀, it will follow that it will require 160 horse power to drive such a dynamo at full load.

The relations between mechanical and electrical measurements are thus very simple and wonderfully accurate.

100 kilowatts, or 100,000 watts, deliver sufficient energy to illuminate 3,000 10 c.p. lamps, and one of the most difficult problems which the electrical engineer has to solve is to design the best and most economical method of distributing this energy over an extended area. If the distribution be confined to one big building, like the Pavilion in Brighton, or the Post Office in London, the solution is simple. If it be over a widely scattered district, like Croydon, Wimbledon, or the districts of the great vestries of London, the solution is complicated. Every district must be governed by its own conditions, and be controlled by its own environments.

There are several modes of distribution under high pressure or low pressure; by means of alternate currents or of continuous direct currents; by two wires or three wires or five wires. Then again, the supply may be for light or motive power, for street lighting, or for private lighting. If it be by high pressure, say of over 300 volts, then, as such pressures cannot be admitted into our houses, there must be a reduction of this pressure to the safe and ordinary 100 or 50 volts by means of alternating transformers or of secondary batteries.

The ruling guide is of course economy. A certain number of kilowatts are generated in the central station, at a price per hour that is easily obtained from the coal bills, the stores list, and the wages sheet. A certain proportion of this energy is delivered to the consumers, and paid for by them by meter or by contract. A certain proportion is lost:—wasted as heat in the apparatus and conductors. What is the proportion between the energy paid for, and that generated by the central station? What is in fact the efficiency of the system? It is difficult in the present tentative and youthful condition of the industry to obtain a true answer. Most central stations are in their pioneer condition. I have however, examined the figures of certain well known systems, from which I gather that we may estimate the following efficiencies as fairly practical:—

	Efficiency.
Low pressure—	
Continuous direct current	90 per cent.
High pressure—	
Alternate current	60 ,,
Direct current battery	50 ,,

In fact, one Company—the St. James and Pall Mall—working on the low pressure system, have on the first half-year of 1890 secured a return of 94·3 per cent. on the energy delivered, while another company, working on the high pressure battery system, secured only 29 per cent.

In January of this year, at the Kensington Court Central Station, working at low pressure, 25,893 bots were registered and paid for, as against 28,291 generated and distributed, representing an efficiency of 92 per cent. At Dacre Street, Westminster, also working at low pressure, in the quarter ending June 24th—the summer and lowest quarter—the efficiency was 84·4 per cent. At the House of Commons the efficiency has been 89·8 per cent.

A simple way of looking at the matter is to find out the coal consumed per bot paid for by the consumer. It comes out—

Low pressure .... 9 lbs.
High pressure .... 17 lbs.

It is worth noting that it would require 38 lbs. of coal distilled in the gas works to produce the same light by means of the ordinary fish-tail burner.

The misfortune is, that the low pressure system is applicable only to confined and restricted districts. It involves the use of such heavy conductors, that as the district increases in extent, the weight of copper required varies as the third power of the radius of the area served. While with the high pressure system the weight of copper required diminishes with the pressure used.

It must however be recollected that the use of high pressure involves the use of very highly insulated conductors, and therefore what is saved in copper may be expended in insulation. The question that decides the economic use of high or low pressure is the distance or length of mains and feeders, when the difference between 17 and 9 lbs. of coal (or a penny per bot) is swallowed up in interest on capital and waste of energy in the heavy conductors required by the low pressure system.

The consequence is that while compact areas, covered by a radius of half a mile, are best served on the low pressure system, those supplied beyond a radius of one mile can be served economically only on the high pressure system; while the intermediate range is to be considered simply with reference to its own requirements and its own conditions, such as the supply of water and of coal, the convenience of water and railway carriage, the value of land, the demand of residential districts, and of manufacturing and business quarters. Each district must therefore be dealt with on its own merits.

In London at the present moment several different systems are being used or installed for very similar districts. Thus we have the alternate current transformer system at Brompton, St. Martin's, St. Giles, and the various portions served by the London Electric Supply Association, the high pressure battery system in Chelsea, the low pressure system aided by secondary

batteries to regulate pressure and to maintain the supply of energy during the small hours of the morning, or when breaks-down or cases of emergency arise, in Kensington, Westminster, St. James's, Notting Hill, and St. Pancras. The proper system to be used is therefore still in a tentative condition.

The great question that divides the merits of the high and low pressure is that of safety to person. Grossly exaggerated accounts of accidents in America have seriously prejudiced the public mind against the high pressure system. If people only saw for themselves the conditions that surround the distribution of electricity in the United States, they would not be surprised at the accidents that have happened—they would wonder at their being so few. Poles are frequently carried down the principal streets of the towns carrying open telegraph, telephone, fire signal, and electric light wires, all together on the same support, without any particular rules or regulations. A lineman who ascends a pole to attend to a telephone wire is very apt to touch suddenly an electric light conductor. He receives a shock, and is thrown down perhaps on the ground and killed, or perhaps among the other wires, where he may be probably burnt or otherwise injured.

Such things are impossible in England. Mains and conductors must, by legislation, be placed underground in all towns; but where they are for local reasons placed overground, they are subjected to carefully prepared rules and regulations, and to watchful and constant inspection. A high pressure conductor would certainly be dangerous if it were handled, but it should never, under any circumstances, be so placed as to be in a position to be touched by anyone but the skilled technical men who have the charge of its maintenance. There is no case on record of anyone being hurt on a well designed underground system.

The great hygienic advantage of the electric light when illumining our dwellings and our workshops is not that it purifies the air, but that it prevents the air from being vitiated by the introduction into it of the products of combustion, such as carbonic acid, carbonic oxide, sulphurous acid, &c., it prevents the air from being weakened by the abstraction of oxygen, and it prevents it from having its temperature raised by undue radiation, and by throwing into it heated gases.

While legislation and the greatest possible stringent regulations have been drawn up to prevent the adulteration of food and the poisoning of water, scarcely any attention has been devoted to the prevention of the admission of noxious gases and poisonous vapours into the air of our habitations. Carbonic oxide is a poison of the deadliest character, and gas jets are

freely used which deliver copious discharges of this dangerous gas into the atmosphere of our rooms. If we were consistent in our legislation, we ought to forbid the use of any burner which thus poisons the air. A man at rest exhales ·00424 cubic feet of carbonic acid gas (CO_2) and ·1189 cubic feet of air per pound weight per hour, while a gas jet burning 5 cubic feet of coal gas exhales 4 cubic feet of CO_2. The maximum proportion of CO^2 to air consistent with health is 6 volumes in 10,000, 10 volumes affect the heart, and 30 volumes produce headaches. Rheumatism, bronchitis, and other ailments proceed from higher proportions. In fact, 5 cubic feet of gas requires 8,000 cubic feet of pure air per hour to maintain it healthy. The electric light requires no such provision.

That the electric light is a powerful element of health is evidenced by the fact that those who use it not only feel all the better for its introduction, but their appetite increases, and their sleep improves, and the visits of the doctor are reduced in frequency. Workpeople work all the better, and absences from illness are far less frequent. In the Savings Bank in Queen Victoria Street, London, where 1,200 persons were employed, the absences from illness were so far reduced, that the extra labour gained paid for the electric light. In Liverpool and many other places the same result has been observed.

The influence of artificial light on the eyes has a very important sanitary bearing. Why is it that there is so much shortsightedness in the present day? Is it due to our mode of producing light? Some assert that the injury to the eyes is due to the heat rays and not the light rays. If that be so the electric light must be much less injurious than any other. On the other hand, no one can have experimented with arc lamps without having had his retina painfully affected, which leads one to think that the ultra-violet rays have some influence. No one has, however, ever complained of the influence of a steady glow lamp upon the eyes, and it is possible to read and to write for many hours by such a light without experiencing the least fatigue.

The electric current is not altogether free from being a cause of fire, and though its use is by no means very general, still it is used sufficiently to make itself felt as an element of danger in this respect. The following table shows the number of fires in London which can be traced to the different methods of lighting:—

	1887.	1888.	1889.	Total.
Lamps	245 ...	205 ...	257 ...	707
Gas	188 ...	197 ...	209 ...	594
Candles	142 ...	113 ...	136 ...	391
Electricity ...	0 ...	1 ...	2 ...	3

The progress of the electric light in our homes has been much more rapid in England than in any other country, but its employment for street-lighting, for shops and manufactories, has been infinitely more rapid and extensive in the United States than with us. In America the growth has been enormous. There are now 250,000 arc lamps, illuminating the public streets and shops, and 3,000,000 glow lamps in dwellings, stores, and workshops.

The following Table shows the development of the Berlin Central Stations :—

Station.	Effective Horse-Power.						
	1884	1885	1886	1887	1888	1889	When Completed.
Friederickstrasse	300	300	300	300	300	300	300
Markgrafenstrasse............	...	1000	1000	1000	2400	2400	3100
Mauerstrasse	...	...	500	1250	1250	2950	4950
Spaudauerstrasse	...	...	...	...	...	2000	4000
Schiffbauerdamm	...	...	...	...	...	1000	6000
Total	300	1300	1800	2950	3550	8650	18350
16 c.p. lamps, or equivalent	2500	4600	13229	24660	34750	...	...
Kilometres of cable	...	8	10	15	25	75	...

The progress in England has been very much checked by inordinate speculation and by terrible failures in some of the earlier work done. There is something very captivating in the practical applications of electricity, and something romantic in its mystery. The neophyte has rushed into it with remarkable fervour, and the lessons of failure have in consequence been very severe. The users of the light have also been paying heavily for the education and experience of amateur tradesmen and inexperienced contractors, and have neglected to avail themselves of the professional services of the experienced electrical engineer. People who would not build houses without the architect, nor construct bridges without the engineer, nor make their wills without the lawyer, rush wildly into the use of electricity without any professional assistance, where, above all things, experience and knowledge are essential to prevent disaster and disappointment. Large installations have been completed without specifications to guide the contractor, and without inspection to see that the work has been properly done. The user has paid violently for his temerity, and fires and accidents have been the result. The heavy price of wiring

a rented house, and the expensive character of the fittings proposed, have deterred many from adopting the light, even when it is within their reach. Highly insulated wire is unfortunately expensive. All cheap wires are nasty and dangerous. There is nothing that becomes the electric light better than simplicity, and its effect is frequently marred by elaborate brass work. It possesses also most active and widespread opponents, both in oil and gas—opponents who have benefited by its introduction, and who are not slow to profit by its advance. The improvements in gas and oil lamps are as marked as the advancements in electric light, and as means of artificial illumination alone—that is as far as light-giving power is concerned—there is little choice between the three, but oil and gas cannot lose those elements of discomfort and ill-health which differentiate them from the cool and pure glow lamp.

A very important question arises for discussion. Legislation has slipped in to place the virtual control of the supply of electrical energy in the hands of the local authority of the district to be served. Is this supply to be the result of the capital of private enterprise, or is it to be effected by raising money on the security of the rates?

It is argued that the supply of electricity being a purely commercial undertaking, it should therefore be carried out by a limited liability company. The Acts of 1882 and 1888 do not encourage monopoly, but rather court competition, and competition attracts capital. Competition properly regulated and controlled secures economy in supply, and certainly enforces economy in working, while it encourages improvements, and induces perfection of apparatus and novelty in processes. These arguments are plausible, but are easily refuted by those who desire to uphold vested monopolies. Direct competition always means ultimately enhanced cost to the public, for the same public has to pay for double plant, and each competitor only gets half revenue.

The supply of light is in precisely the same category as the supply of water or the supply of gas, and the days have certainly passed when the public will tamely submit to the transference of their right to such vested interests as those of water or gas companies.

It is very easy to argue pro or con on each side. The local authority has to regard the security of traffic, the safety of person, the repression of crime, and the proper supervision of the premises of its ratepayers. It is the custodian of the public interests. It has to control the health, cleanliness, comfort, and beneficial sanitation of its habitable dwellings. It therefore must secure the best light, and if it can do this, and at the

same time relieve the rates which are generally creeping up to dangerous dimensions, then its action would be wise and economical. But it would be entering into commercial rivalry with an active competitor—the Gas Companies; and its commercial control by such a shifting authority as a committee of a Town Council or of a Local Board, subject to the changes of political warfare—to the vagaries of press dictation, and to the fear of November elections—is a very doubtful proceeding. On the other hand, in many instances, such bodies have successfully dealt with the water question, the tramways, and even with the gas. In fact, one-third of the gas capital (21 millions) in this country is in the hands of 173 Local Authorities, and more than half a million of profits go to the reduction of rates.

Bradford has already grappled with the question. It has established a central station for the supply of the electric light. Brighton, St. Pancras, and Bristol are doing the same, and many other places are following suit. They are shying at the probability of handing over their districts to a speculative company, with a virtual though not a legal monopoly, to supply electrical energy for 42 years. Many corporations contemplate a middle course. They have obtained the power for themselves, but they have farmed for shorter terms the right of supply to private enterprise, which can do what they are afraid to do, viz., speculate and experiment. The Board of Trade has sanctioned and facilitated such a transfer of statutory rights.

It is surprising that Gas Administrations in England have not been more enterprising in developing Electric Lighting. In Vienna, Rome, and Stockholm the Gas Companies have established Central Stations, and the progress of the industry in those cities is very great. The proper function of gas is to supply heat, not light, and as a source of power it has a future more brilliant than its past. If it could be supplied as fuel it would remove the troubles of coal transit and storage, of ash and dust removal, of smoke and of stoking. It has even been shown that it is cheaper to convert coal into gas on the spot, and to use the gas as the source of power, than to apply the coal direct for the production of steam in boilers. The waste of energy in the use of coal is enormous. The energy contained in one pound of coal if burnt in one hour is theoretically sufficient to supply 5·6 horse-power for that hour. The best practical result yet obtained by the steam engine is scarcely one horse-power.

The electric light is unquestionably the light of the future. Its use is advancing with leaps and bounds. Not only is it naturally the proper source of light, but economically it must

eventually supplant its rivals. When electrical energy is generally distributed through our towns, and its supply is continuous, and properly controlled, so that it is always within the reach of all; and when means can be devised to wire up houses as cheaply as they are now fitted for gas, everyone will take it, not alone for its beauty, but because it is, above all, a source of health and comfort.

WORKING HOURS FOR WORKING MEN.

LECTURE TO WORKING CLASSES.

By B. W. RICHARDSON, M.D., F.R.S.

Dr. Richardson brought the work of the Congress to a close by delivering a lecture to the working classes. Choosing for his subject, "Working Hours for Working Men," the Lecturer opened by expressing regret that at such congresses as these the working classes could not take an active part throughout with the other members, and he anticipated the day when this would certainly be done. He then proceeded to treat on work as every man's portion, and on the value of work, not only as a fact, but as an idea, provocative of good results even from the humblest worker. Next he dwelt on the will in relation to work, and coming to the apportionment of work in relation to hours of work, from a sanitary and health point of view alone, he fixed on the period of eight hours as an excellent standard of time, not absolute, because quality of work varied so much, but as a fair average. The reason why such a standard is not followed, is not so much the fault of the employer or employed, as of the public at large, which continually, in the most exacting manner, makes hard workers keep long hours really for no useful purpose whatever. One part of the great reformation in hours of labour should therefore begin by lessening the demand for long hours through all classes of the community. Bodily powers and hours of work then came under review, in which review it was first shown that, whether he will or not, every man has to perform an amount of work which is rather startling when it is fully computed. Thus the work performed by the heart of a man every twenty-four hours, equal to the task of raising one hundred and twenty-two tons one foot, is of itself a striking illustration of work that must be done. This was followed by a description of added work thrown upon the body by daily labour; and here it was indicated that it is not usually the case that work injures by being thrown on the body as a whole, but

by its being thrown upon one particular part or organ of the body, which thereupon wears out first, and is the cause, by its failure, of premature death. From the same circumstance certain occupations wear out life much sooner than others, and in these limitation of hours of work ought always to be insured. Three classes of work are of special moment: (1) where with bodily exertion the intensest watchfulness is demanded—example, the railway engine driver; (2) where the work is one continued grind and monotony—example, the postman; (3) where the work is excessively hard, as in pile driving, by which the full natural work of 240 foot tons per day may be raised to a third more. Dr. Richardson also noticed occupations in which the body, while at work, is in a bent position. In every such instance the period of eight hours for work is the maximum, and is often too long. In other occupations where work is intermitted or is very light, although hours may seem long, the labour may not be hurtful. In essence the argument went to show that for health's sake work ought to be measured out according to the strain which it puts on the body or the mind, or on both together; and the lecturer's contention was that work might be measured out on the principle of adapting this application of the powers of man to his proper working necessities.

Some objections which might be made to the arguments that had been advanced were next stated and met: such as the objection that man is not a mere machine; that some luxuries, like indulgences in alcoholic drinks, may wear out more determinately and rapidly than the hardest work; and that many men who have no occasion to work injure themselves by physical pleasures and labours quite as much as those who work for their bread. The objections were admitted in so far as results might be concerned, but it was urged that between these self-imposed means for shortening life and the work which is inflicted by assumed necessity during daily working-class labour there is no necessary connection whatever.

To the varieties of wearing labours to which reference had already been made, Dr. Richardson added several others, and supplied a number of facts showing how under many occupations specified life was necessarily shortened. He showed also how in the same occupation, that of the blacksmith for example, the value of life is reduced by the addition of hours of extra work to hours of ordinary and fair work.

The latter part of the lecture was devoted to the subject of relaxation of work, days of rest and of recreation—holidays. The necessity for full recreation was strongly insisted on. Of all things, Sunday ought to be retained as a day of rest from labour, not in the fashion of the Jewish Sabbath, nor in the

stern Puritan fashion, but as a day of pure and rational rest, with change of mind as of body from the common toils of the week to communion with the Lord of Nature in all His works and ways, and through those who present the beautiful in nature with the greatest art and greatest purity. With an eight hours system of labour, there must be introduced a better system of recreation during week days, in which good music must play a first part. Dr. Richardson repudiated *in toto* the notion that working men and women were not wishing for better and healthier pleasures than any they had up to this time enjoyed. To them recreation has never yet come in good form, but it will come in good form with the effect of lightening the pressure of common labour, by inducing new labourers to enter the wider fields of art and learning for the instruction and entertainment of the people.

Bank holiday formed the last topic, on which debatable subject Dr. Richardson broke new ground. He contended that bank holiday, from its crush, its shortness, and head over heels character, and with its entire dependence on the weather for pleasure or pain, ought to be revised, and that working men and women, like those of other classes, should have their longer vacation at convenient times or as they required it for the recreation and health of them and their families.

Touching the whole question of labour, an example bearing to millions of minds a meaning as beautiful as it is forcible requires to be set. The yoke must be made easy, the burden light, before the healthy working heart can beat out to its full days the healthy body and the healthy mind.

OBJECTS OF THE INSTITUTE, RULES FOR THE ADMISSION OF MEMBERS, &c.

The Objects of the Institute are: To promote the advancement of Sanitary Science in all or any of its branches, and to diffuse knowledge relating thereto.

Examinations are held, and Certificates of Competency in Sanitary knowledge are granted. The Examinations are held in London and also in Provincial centres, and as at present arranged, are adapted for Local Surveyors and Inspectors of Nuisances.

Courses of Lectures and Demonstrations for Sanitary Officers, specially adapted for Candidates preparing for the Institute's Examination for Inspectors of Nuisances, are held twice a year preceding these Examinations; a nominal admission fee is charged for each course.

A Congress for the consideration of subjects relating to Hygiene, and an Exhibition of Sanitary Apparatus and Appliances, are usually held annually by the Institute.

Fellows, Members, and Associates are entitled to attend all meetings and Congresses of the Institute, and to take part in the discussions, and have free admission to any Conversazione given by the Institute, and to Exhibitions of Sanitary Appliances held in connection with the Institute, so long as they continue to pay their Subscription.

Holders of Half-Guinea Congress Tickets are entitled to the use of the Reception Room in the town of meeting, and to admission to the Presidential and other Addresses; to all the Meetings of the Congress; to the Exhibition of the Institute; and to any Conversazione given by the Institute.

At the Congress many valuable papers in connection with Sanitary Science are read and discussed, and are printed in the volume of Transactions, which volume also contains a Report upon the Exhibition of Sanitary Apparatus and Appliances held in connection with the Congress.

Sessional Meetings of the Institute are held in London from time to time, for the reading of papers and for discussions upon subjects connected with Sanitary Science.

Lectures and Demonstrations for Medical Men, on subjects relating to Hygiene, are given in the Summer months.

Lectures on Domestic Hygiene, specially intended for Ladies, are given during Lent.

The Parkes Museum, which is maintained by the Institute, contains a great variety of the most approved forms of apparatus and appliances relating to health and domestic comfort—for instance, the drainage of the Museum itself has been planned by Mr. ROGERS FIELD, M.INST.C.E., and Professor W. H. CORFIELD, M.A., M.D., and has been arranged so as to be open to inspection; by which means a practical illustration is afforded of one of the best methods of overcoming difficulties commonly met with in the drainage of town houses.

There is a continuous water supply, and about forty of the most approved forms of Sanitary Apparatus, consisting of Closets, Water Waste Preventers, Flush Tanks, &c., are arranged in a separate corridor, and may be seen in operation.

Various forms of Drain Pipes, Soil Pipes, Disconnecting Apparatus, and Models of Systems of Drainage, are on exhibition.

Numerous methods of Ventilation and Warming are exhibited.

Stoves, Fire-places, and Gas Stoves, which combine recent Hygienic improvements, are in use in the Museum, and others are on exhibition. Cowls and Terminals for Chimneys, Air Shafts, and Drain Ventilators, are on view.

Various gas-lights, arranged to prevent the products of combustion from mixing with the air of the room, are in use in different parts of the building.

Specimens showing methods of, and materials for, house construction, as well as materials applicable to the treatment of walls, floors, and ceilings are exhibited, together with Models and Plans of Dwellings, Hospitals, and other buildings.

The Museum contains an admirable collection illustrating the constituents and preparation of food, arranged by Mr. THOMAS TWINING, of Twickenham.

Professors of Hygiene are allowed the use of the Museum for Demonstrations to their Students.

In order to preserve the Educational character of the Museum, it

is essential that the Council should be continually adding new inventions to the collection, and as the space is limited, it is necessary for them to retain the power of changing the exhibits from time to time; this precludes any charge being made to exhibitors for space in the Museum.

There is a large Library of Sanitary Literature, which contains, in addition to standard works on Sanitary Science, a collection of Reports of Medical Officers of Health over the whole country; and a Reading Room supplied with the principal Sanitary periodicals, both home and foreign.

The Council earnestly request authors of works on Hygiene and the allied Sciences to present copies of their books to the Library.

The Museum is open daily from 10 a.m. to 6 p.m., and on Mondays to 8 p.m., and is free to the public except when Lectures or Meetings are being held. The Library and Reading Room are open daily from 10 a.m. to 6 p.m., for the use of Members, Associates, and Students.

Members are elected by ballot by the Council. The Admission Fee payable by a Member is £3 3s., and the Annual Subscription £2 2s.

Any person elected a Member who shall either be a Medical Officer of Health, or have from some Examining Body a Sanitary Science Certificate (the sufficiency of which Certificate shall be recognised by the Council), or be both a Surveyor having his appointment from some Parliamentary Sanitary Authority and a Member or Associate Member of the Institution of Civil Engineers, or hold the Certificate of the Sanitary Institute of Great Britain or of this Institute, of competency for the appointment of a Local Surveyor, shall pay the smaller Annual Subscription of £1 1s., and shall be exempt from the payment of any Entrance Fee.

Members desirous of becoming Life Members may do so on payment of £21, in lieu of the Annual Subscription.

Fellows are elected by the Council from the Members of one year's standing, on one or other of the following grounds:—

1. That he is an eminent man of science. 2. That he is a person of distinction as a legislator or an administrator. 3. That he is a person who has done noteworthy sanitary work.

Honorary Fellows.—Foreigners distinguished in connection

with sanitary science can be elected by the Council. Honorary Fellows are not corporate members of the Institute.

Associates are elected by ballot by the Council. The Admission Fee payable by Associates is £2 2s., and the Annual Subscription £1 1s.

Associates who, at the time of their election, shall either have received the Certificate of the Sanitary Institute of Great Britain or of this Institute, of competency for the appointment of Inspector of Nuisances, or who have held the appointment of Inspector of Nuisances in any district at the date of the incorporation of the Institute, shall pay the smaller Annual Subscription of 10s. 6d., and shall be exempt from the payment of any Entrance Fee.

Associates are not Corporate Members of the Institute.

Forms of application for admission to the Institute, and the Examinations; and all further information can be obtained from the Secretary.

The Following Arrangements have been made for the Session, 1891.

Sessional Meetings for Communications and Discussions on Sanitary Subjects, Wednesdays, February 11th, March 11th, and April 8th, at 8 p.m.

Lectures and Demonstrations for Sanitary Officers, specially adapted for Candidates preparing for the Institute's Examination for Inspectors of Nuisances. Two Courses each of Sixteen Lectures on Tuesdays and Fridays at 8 p.m., the first commencing on January 30th, and the second on October 6th.

Examinations for Surveyors and Inspectors of Nuisances:—*For Dates and Towns in which they are held, see page* 289.

Lectures on Domestic Hygiene, specially intended for Ladies. A Course of Four Lectures on Tuesdays and Fridays at 3 p.m., commencing March 3rd.

Ordinary General Meeting for 1891, Tuesday, March 17th.

EXAMINATIONS IN SANITARY SCIENCE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

BOARD OF EXAMINERS.

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HENRY LAW, M.INST.C.E.
W. H. MICHAEL, Q.C., F.C.S., M.R.C.S.
LOUIS PARKES, M.D., PUB. HEALTH CERT.LOND.
PROF. H. ROBINSON, M.INST.C.E.
H. SAXON SNELL, F.R.I.B.A.
J. F. J. SYKES, M.B., B.SC.PUB.HEALTH.
ERNEST TURNER, F.R.I.B.A.

THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances, in connection with the various Acts relating to Public Health, Drainage and Water Supply, the Sale of Food and Drugs, &c., led the Council of the Sanitary Institute of Great Britain in 1877 to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency in Sanitary knowledge.

The Sanitary Institute, in which the older body has been incorporated, is continuing this important work.

The Examinations are arranged in two grades, and are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their competency in the subjects of Examination. A register of successful Candidates is kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application. Many Boards and Corporations require Candidates, when making applications for appointments, to produce a certificate of this kind.

Up to Dec., 1890, 33 Examinations had been held; 1132 Candidates had been examined, 170 as Local Surveyors, and 962 as Inspectors of Nuisances; of these 657 passed the Examinations and received Certificates, 70 as Local Surveyors, and 587 as Inspectors.

In order to make the Examinations for Inspectors more accessible to persons residing in the country, the Council have arranged to hold periodical Examinations in the following centres, in addition to the Examinations held in London, provided that at least 20 Candidates send in applications for Examination:—Newcastle-on-Tyne; Liverpool, Leeds or Manchester; Birmingham or Bristol; London.

These Examinations in the Provinces will be carried out in the same way as the Examinations in London, and similar Certificates will be granted. It is hoped that later on arrangements may be made for holding them also in Scotland and in Ireland.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies six hours—viz., usually from 11 a.m. till 2 p.m., and from 3 till 6 p.m., and consists of written papers only. Inspectors of Nuisances have three hours' written Examination on the first day—viz., usually from 11 a.m. to 2 p.m. On the second day the Examination, for each class, usually commences at 11 a.m., and is *vivâ voce*, with one or more questions to be answered in writing, if deemed necessary.

Every Candidate is required to furnish the Board of Examiners with satisfactory testimonials as to age and personal character, and to give two weeks' notice previous to presenting himself for Examination. The fee for Examination must be paid to the Secretary, by Post-Office order or otherwise; 10s. 6d. on making application, and the remainder at least one week before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

No one under 21 years of age is admitted to the Examinations.

A Certificate of Competency, signed by the Examiners and bearing the Seal of the Institute, is granted to each successful Candidate; but it must be distinctly understood that no Certificate will be granted to any Candidate unless he can write legibly, spell correctly, and possesses a fair knowledge of arithmetic, so that he may be able to prepare a report on any subject connected with his duties, creditable to himself and to the Authority employing him.

The fees payable for the Examination are as follows:—

As Surveyors, £5 5s.
As Inspectors of Nuisances, £3 3s.

But when the Examinations are held in Provincial Towns, £1 1s. extra will be charged to the Candidate in order to cover the expenses incurred in holding an examination out of London.

Unsuccessful Candidates are allowed to present themselves at any other Examination within twelve months on payment of half fees.

The probable date of the Examinations for 1891 are as follows:—

For Surveyors—

London—Friday and Saturday, June 5th and 6th.

For Inspectors of Nuisances—

Birmingham—	Friday and	Saturday,	February 13th and 14th.
London—	,,	,,	April 10th and 11th.
Newcastle—	,,	,,	June 26th and 27th.
London—	,,	,,	December 4th and 5th.
Manchester—	,,	,,	December 18th and 19th.

The forms to be filled up before the Examination, by Candidates and by those persons recommending them, will be supplied on application to the Secretary.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

(1.) Laws and Bye-Laws—A thorough knowledge of the Acts affecting Sanitary Authorities, as far as they relate to the duties of Local Surveyors; also, of the Model Bye-Laws issued by the Local Government Board.

(2.) Sewerage and Drainage—The Sanitary arrangements of houses,

including internal drainage, the construction of water-closets, privies, and dry-closets, the removal and disposal of refuse; the Sanitary defects of Builders and Plumbers' work; the Sanitary principles of Sewerage and Drainage and their application in the preparation of schemes for, and in the construction of, Sewerage works; the flushing and ventilation of sewers, and the treatment and disposal of sewage.

(3.) WATER SUPPLY OF TOWNS AND HOUSES—The sources of water, methods of collecting, purification (filtration, softening, &c.), and distribution. The Sanitary principles of Water Supply, and their application in the preparation of schemes for, and in the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

(4.) STRUCTURAL—Regulation of Cellar Dwellings and Lodging Houses, and of Baths and Wash-houses; General principles of Ventilation and their practical application; the amount of air and space necessary for men and cattle: the means of supplying air, and of ensuring its purity.

(5.) HIGHWAYS AND STREETS—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

Candidates will be required to make free-hand sketches.

Any person having passed the above Examination and received the Certificate for Local Surveyor is, upon proposal and election as Member of the Institute, by virtue of holding such Certificate, exempt from payment of the Entrance Fee, and will only be called upon to pay the reduced subscription of £1 1s. annually.

FOR INSPECTORS OF NUISANCES.

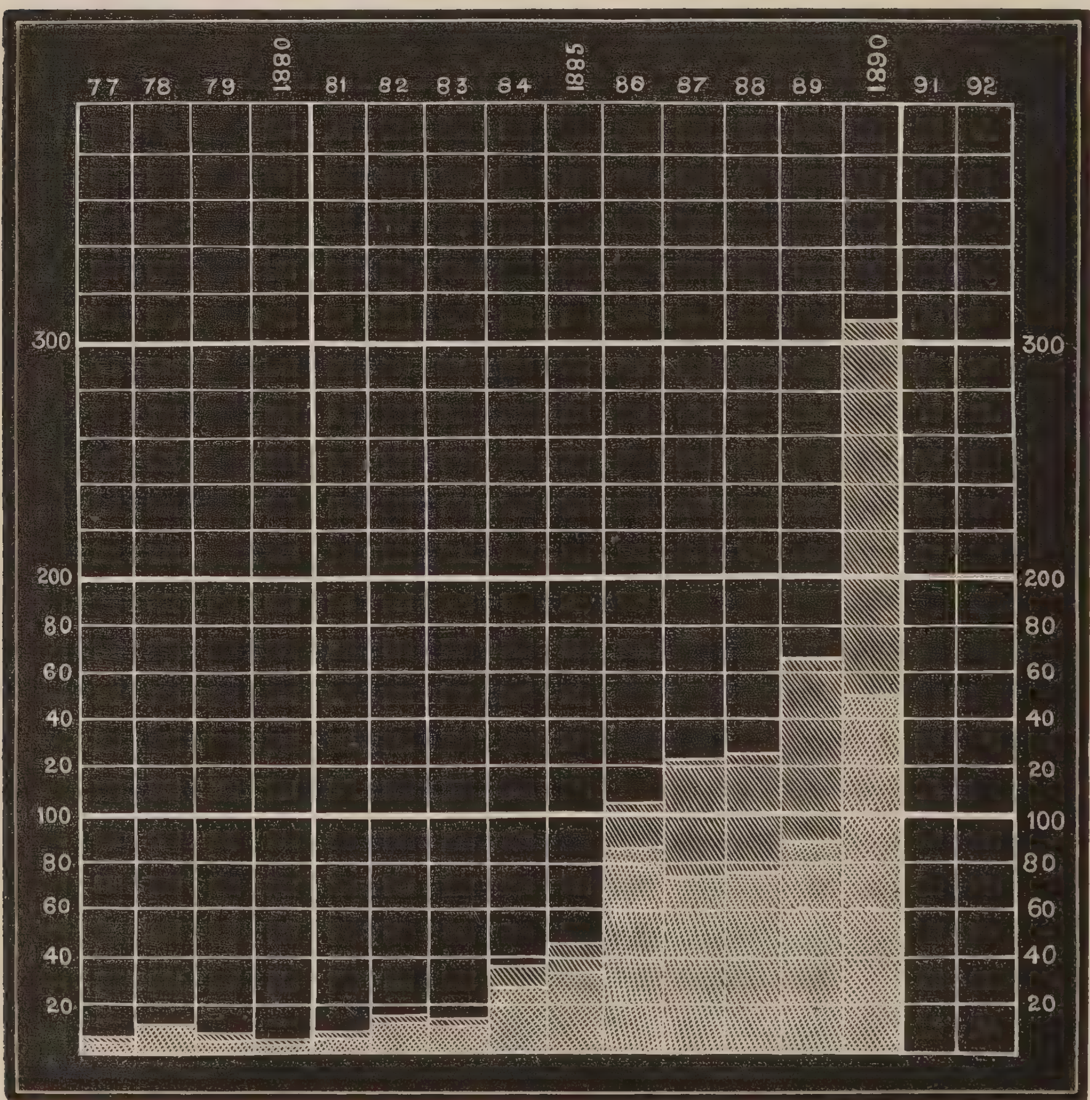
Duties of Inspectors of Nuisances as defined by the Local Government Board.	Syllabus of Subjects for Examination.
(1.) He shall perform, either under the special directions of the Sanitary Authority, or so far as authorized by the Sanitary Authority, under the directions of the Medical Officer of Health, or in cases where no such directions are required, without such directions, all the duties specially imposed upon an Inspector of Nuisances by the Public Health Act, 1875, or by the Orders of the Local Government Board, so far as the same apply to his office.	The Provisions of the Acts and Model Bye-Laws relating to the duties of Inspectors of Nuisances.
(2.) He shall attend all meetings of the Sanitary Authority when so required. (3.) He shall by inspection of the District, both systematically at certain periods, and at intervals as occasion may require, keep himself informed in respect of the nuisances existing therein that require abatement under the Public Health Act, 1875. (4.) On receiving notice of the existence of any nuisances within the District, or of the breach of any by-laws or regulations made by the Sanitary Authority for the suppression of nuisances, he shall, as early as practicable, visit the spot, and inquire into such alleged nuisance or breach of by-laws or regulations. (5.) He shall report to the Sanitary Authority any noxious, or offensive businesses, trades, or manufactories established within the District, and the breach or non-observance of any by-laws or regulations made in respect of the same.	A knowledge of what constitutes a Nuisance. Methods of Inspection, of Dwellings, Cellar Dwellings, Dairies, Milk-shops, Markets, Slaughter-houses, Cow-sheds, and Nuisances especially connected with Trades and Manufactories.
(6.) He shall report to the Sanitary Authority any damage done to any works of water supply, or other works belonging to them, and also any case of wilful or negligent waste of water supplied by them, or any fouling by gas, filth, or otherwise, of water used for domestic purposes.	The Physical Characteristics of good Drinking Water—the various ways in which it may be polluted, by Damage to Supply Works or in Houses, and the means of preventing pollution—Methods of Water Supply.

(7.) He shall from time to time, and forthwith upon complaint, visit and inspect the shops and places kept or used for the sale of butchers' meat, poultry, fish, fruit, vegetables, corn, bread, flour, or milk, or as a slaughter-house, and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk which may be therein; and in case any such article appear to him to be intended for the food of man, and to be unfitfor such food, he shall cause the same to be seized, and take such other proceedings as may be necessary in order to have the same dealt with by a Justice: Provided, that in any case of doubt arising under this clause, he shall report the matter to the Medical Officer of Health, with the view of obtaining his advice thereon.	The Characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables).
(8.) He shall, when and as directed by the Sanitary Authority, procure and submit samples of food, drink, or drugs suspected to be adulterated, to be analysed by the analyst appointed under "The Sale of Food and Drugs Act, 1875," and upon receiving a certificate stating that the articles of food, drink, or drugs are adulterated, cause a complaint to be made, and take the other proceedings prescribed by that Act.	The sale of Food and Drugs' Act.
(9.) He shall give immediate notice to the Medical Officer of Health of the occurrence within the district of any contagious, infectious, or epidemic disease; and whenever it appears to him that the intervention of such officer is necessary in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall forthwith inform the Medical Officer of Health thereof.	The Regulations affecting persons suffering or recovering from Infectious diseases, and some knowledge of such diseases—The principles of Ventilation, and simple methods of Ventilating Rooms—Measurement of Cubic Space.
(10.) He shall, subject to the directions of the Sanitary Authority, attend to the instructions of the Medical Officer of Health with respect to any measures which can be lawfully taken by an Inspector of Nuisances under the Public Health Act, 1875, for preventing the spread of any contagious, infectious, or epidemic disease of a dangerous character.	Disinfectants and Methods of Disinfection.
(11.) He shall enter from day to day, in a book to be provided by the Sanitary Authority, particulars of his inspections and of the action taken by him in the execution of his duties. He shall also keep a book or books, to be provided by the Sanitary Authority, so arranged as to form, as far as possible, a continuous record of the sanitary condition of each of the premises in respect of which any action has been taken under the Public Health Act, 1875, and shall keep any other systematic records that the Sanitary Authority may require. (12.) He shall at all reasonable times, when applied to by the Medical Officer of Health, produce to him his books, or any of them, and render to him such information as he may be able to furnish with respect to any matter to which the duties of Inspector of Nuisances relate.	A Knowledge of the General Duties of the Office, and Methods of keeping the necessary Books and Records. Writing and Spelling.
(13.) He shall, if directed by the Sanitary Authority to do so, superintend and see to the due execution of all works which may be undertaken under their direction for the suppression or removal of nuisances within the district.	The proper conditions of good Drainage—The advantages and disadvantages of various Sanitary Appliplances for Houses—Inspection of Builders and Plumbers' work—Scavenging and the Disposal of Refuse.

Any person having passed the above Examination and received the Certificate for Inspectors of Nuisances is, upon proposal and election as Associate of the Institute, by virtue of having such Certificate, exempt from payment of the Entrance Fee, and will only be called upon to pay the reduced subscription of 10s. 6d. annually.

Table shewing the number of Candidates examined and certified each year; and Diagram relating to the Inspectors' Examination only.

Year.	Number Examined.			Certificated.				
				Number.			Per cent. of Total.	
	Surveyor	Inspector	Total.	Surveyor	Inspector	Total.	Surveyor.	Inspector.
1877	3	5	8	2	3	5	*67*	*60*
1878	11	10	21	3	10	13	*27*	*100*
1879	4	6	10	2	4	6	*50*	*67*
1880	10	3	13	6	2	8	*60*	*67*
1881	7	7	14	2	6	8	*29*	*86*
1882	6	15	21	3	13	16	*50*	*87*
1883	7	13	20	3	11	14	*43*	*85*
1884	14	36	50	7	27	34	*50*	*75*
1885	20	44	64	5	33	38	*25*	*75*
1886	19	105	124	9	86	95	*47*	*82*
1887	17	122	139	7	75	82	*41*	*61*
1888	25	124	149	8	77	85	*32*	*62*
1889	9	165	174	5	89	94	*56*	*54*
1890	18	307	325	8	151	159	*44*	*49*
	170	962	1132	70	587	657	*41*	*51*



EXHIBITIONS OF SANITARY APPARATUS AND APPLIANCES.

The Exhibitions of Sanitary Appliances are held annually in connection with the Autumn Congress, and unpatented exhibits are protected by a certificate granted by the Board of Trade, under the Patents Designs and Trade Marks Act, 1883.

Judges are appointed by the Council to examine the several exhibits, and award Medals and Certificates of Merit to such objects as they may consider worthy.

Selected exhibits of such a nature as to require practical trials which cannot be carried out on the spot, are submitted to such trials subsequent to the close of the Exhibition.

The Exhibits are arranged in the following Classes:—

CLASS I.—Building Materials, Construction and Machinery.

Sec. 1.—Materials and Construction.
„ 2.—Damp-proof Courses.
„ 3.—Paints & other Protectives.
„ 4.—Wall Papers and Coverings.
„ 5.—Flooring.
„ 6.—Decorative Materials.
„ 7.—Machinery and Mechanical Appliances.
„ 8.—Laundry Appliances.

CLASS II.—Water Supply and Sewerage.

Sec. 1.—Apparatus for Water Supply.
„ 2.—Filtering & Softening Water.
„ 3.—Water Waste Preventers.
„ 4.—Flushing and Watering.
„ 5.—Sinks.
„ 6.—Baths and Lavatories.
„ 7.—Water Closets.
„ 8.—Urinals.
„ 9.—Sewers, Drain Pipes, and Accessories.
„ 10.—Traps and Gullies.
„ 11.—Dry Closets.
„ 12.—Sewage Treatment.
„ 13.—Miscellaneous Sanitary Goods.

CLASS III.—Heating, Lighting and Ventilating.

Sec. 1.—Heating Apparatus.
2.—Cooking Apparatus.
Sec. 3.—Smoke Preventing Appliances.
„ 4.—Lighting, including Electric Lighting.
„ 5.—Ventilating Gas Burners.
„ 6.—Ventilators.

CLASS IV.—Personal Hygiene, Foods, Filters & Disinfectants.

Sec. 1.—Clothing.
„ 2.—Beds and other Furniture.
„ 3.—Hospital and Sick-room Appliances.
„ 4,—Domestic Appliances.
„ 5.—School Fittings.
„ 6.—Gymnastic Apparatus.
„ 7.—Foods.
„ 8.—Domestic Filters.
„ 9.—Mineral Waters.
„ 10.—Soaps and other Detergents.
„ 11.—Antiseptics & Disinfectants.
„ 12.—Disinfecting Apparatus.

CLASS V.—Miscellaneous.

Articles of Sanitary interest not included in the above Classes, such as:—

Sec. 1.—Scientific Instruments.
„ 2.—Books and Periodicals
„ 3.—Prevention of Accidents.
„ 4.—Respirators & Face Guards for Unhealthy Occupations.
„ 5.—Fire Preventing Appliances.
„ 6.—Methods for the Disposal of the Dead, &c., &c., &c.
„ 7.—Sundries.

EXHIBITIONS HELD IN CONNECTION WITH THE CONGRESSES OF THE INSTITUTE.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.	1883. Glasgow.	1884. Dublin.	1885. Leicester.	1886. York.	1887. Bolton.	1889. Worcester.	1890. Brighton.
Number of Exhibitors	117	116	189	106	110	126	134	135	130	112	108	108
Number of Exhibits	294	319	710	500	600	750	900	1,000	900	800	800	1,000
Space occupied (in square ft.)	......	......	......	9,725	14,520	20,000	40,000	30,000	30,000	25,000	28,000	30,000
Number of days Exhibition was open	14	16	17	19	25	25	19	17	26	29	23	18
Total number of Visitors	......	......	......	8,955	8,373	20,000	35,000	37,000	30,000	27,000	23,000	35,000
Number of Medals awarded	13	13	12	12	15	21	18	34	16	14	23	23*
Number of Special Certificates	None.	6	9	7	4	13	11	11	12	9	None.	None.
Number of Certificates	None.	22	38	40	72	58	83	79	64	40	56	67*
Number of Exhibits deferred for further trial	......	7	52	30	37	44	39	119	42	46	67	67

* These do not include all the awards which may be given for Exhibits selected for further practical trial.

CONGRESS AND EXHIBITION AT BRIGHTON, 1890.

Awards of the Judges of the Exhibition.

MEDALS.

BURMANTOFT'S WORKS, LIMITED, *Leeds*, for Exhibit of Decorative Pottery and Faience.

CLEMENS, ABELL & CO., *Worcester*, for Street Sweeping Machine.

GREENALL, JOHN, 120, *Portland Street*, *Manchester*, for Greenall's Steam Washer.

CLIFF, JOSEPH, & SON, *Leeds Fire Clay Company*, *Leeds*, for "Cecil" Slop Sink.

CLIFF, JOSEPH, & SON, *Leeds Fire Clay Company*, *Leeds*, for "Imperial" Porcelain Bath.

TYLOR, J., & SONS, 2, *Newgate Street*, *London*, *E.C.*, for "Ariston" Slop Sink and Water-closet combined.

MOULE'S PATENT EARTH CLOSET CO., 5*a*, *Garrick Street*, *London*, *W.C.*, for Moule's Earth Closets.

BURMANTOFT'S WORKS, LIMITED, *Leeds*, for Decorative Faience Fire-places and Mantels.

STOTT, J., & CO., 174, *Fleet Street*, *London*, for Mercury Gas Governor.

HAYWARD BROTHERS & ECKSTEIN, 187, *Union Street*, *London*, *S.E.*, for Reflecting Pavement and Roadway Lights.

THE CELLULAR CLOTHING CO., LIMITED, 75, *Aldermanbury*, *London*, *E.C.*, for Cellular Fabrics.

BURROUGHS, WELLCOME & CO., *Snow Hill Buildings*, *London*, *E.C.*, for Improvements in Pharmaceutical Preparations.

DANN, A., *The Creamery*, *Western Road*, *Brighton*, for Model Working Dairy.

HAMMER, GEORGE M., & CO., 370, *Strand*, *London*, *W.C.*, for School Furniture.

BRAND & CO., 11, *Little Stanhope Street*, *Mayfair*, *London*, *W.*, for Meat Preparations.

CLARK, J. J., *Goldstone Farm Bread Factory*, *West Brighton*, for Improvements in Bread Making.

CALVERT, F. C., & CO., *P.O. Box* 513, *Manchester*, for Carbolic Acid and Preparations of it.

LYON, WASHINGTON, 85, *Asylum Road*, *Peckham*, *S.E.*, for Steam Disinfector.

ALLEN, W. H., & CO., 13, *Waterloo Place*, *London*, *S.W.*, for Sanitary Publications.

Brighton Volunteer Fire Brigade, *Brighton*, for Models of Fire Extinguishing Appliances.

London, Brighton, and South Coast Railway, *London*, for Models of Railway Rolling Stock and Appliances.

Hayward Bros. & Eckstein, 187, *Union Street, London, S.E.*, for Self-locking Coal Plate.

Swift, James, & Son, 81, *Tottenham Court Road, London W.*, for Microscopic Apparatus.

CERTIFICATES.

Hammer, George M., & Co., 370, *Strand, London, W.C.*, for Exhibit of Church Fittings.

Smeaton, John, Son & Co., 50, *Great Queen Street, London, W.C.*, for Excelsior Dust Shoot.

Beaumont, E. A. B., *Regency Square, Brighton*, for Crutch with Side Handle.

Merryweather & Sons, *Greenwich Road, London, S.E.*, for Armoured India-rubber Hose.

Smith, Collier & Co., 29, *Aldermanbury, London, E.C.*, for Venetian Blind Fittings.

Wire-wove Roofing Co., *Queen Victoria Street, London*, for Wire-wove Roofing.

Beves & Co., 117, *Church Street, Brighton*, for Wood Moulding.

Harris, J. F & G., 58 *&* 60, *Wilson Street, Finsbury, E.C.*, for Fancy Wood Decorations.

Cresswell, Henry, 562, *Western Road, Hove, Brighton*, for Decorative Tiles and Pottery.

Haines, J., 70, *Church Road, Brighton*, for Artistic Pottery and Porcelain.

Brighton Water Works, *Brighton*, for Baker's Water Hydrant.

Clemens, Abell & Co., *Worcester*, for Improved Chain Pump.

Cliff, Joseph, & Sons, *Leed's Fire-clay Company, Wortley, Leeds*, for White Enamelled Fire-clay Sinks.

Tylor, J., & Sons, 2, *Newgate Street, London, E.C.*, for Lavatory Basins and Fittings.

Bostel Bros., 18, *Duke Street, Brighton*, for Lavatories.

Smeaton, John, Son & Co., 50, *Great Queen Street, London, W.C.*, for Imperial Spray Bath.

Burn & Baillie, 14, *Newcastle Street, Farringdon Street, London*, for Combination Bath Fittings.

Burn & Baillie, 14, *Newcastle Street, Farringdon Street, London*, for Lavatory with Overflow which can be cleansed.

Burn & Baillie, 14, *Newcastle Street, Farringdon Street, London, E.C.*, for Hinged Grating for Overflow of Bath.

TYLOR, J., & SONS, 2, *Newgate Street, London, E.C.*, for "Weir" Overflow Valve Water-closet.

TYLOR, J., & SONS, 2, *Newgate Street, London, E.C.*, for "Column" Water-closet.

BURN & BAILLIE, 14, *Newcastle Street, Farringdon Street, London, E.C.*, for Improved Urinal.

DOULTON & CO., *Lambeth, London, S.E.*, for "Special" Urinal.

BOSTEL BROS., 18, *Duke Street, Brighton*, for Collar Joint for connecting Water-closet to Soil Pipe.

BOSTEL, D. T., 73, *Ebury Street, London*, for Union Joint for connecting Water-closet to Soil Pipe.

BURN & BAILLIE, 14, *Newcastle Street, Farringdon Street, London*, for Cast Iron Drain Pipes Inspection Chamber and Traps.

DURRANS, T. H., & SONS, 43, *Upper Baker Street, London*, for Metallic Jointed Manhole Cover with Metal-faced Joint.

CLIFF, JOSEPH, & SONS, *Leeds Fire-clay Company, Wortley, Leeds*, for Winser's Channel Bends.

BURN & BAILLIE, 14, *Newcastle Street, Farringdon Street, London*, for Brass Traps for Baths and Sinks.

CLIFF, JOSEPH, & SONS, *Leeds Fire-clay Company, Wortley, Leeds*, for Stokes's Gully.

CLIFF, JOSEPH, & SONS, *Leeds Fire-clay Company, Wortley, Leeds*, for "Beancliff" Disconnecting Trap.

BURN & BAILLIE, 14, *Newcastle Street, Farringdon Street, London*, for India-rubber Expanding Plug for Drain-testing.

CLEMENS, ABELL & CO., *Worcester*, for Street Watering Van.

SANITARY & DOMESTIC ENGINEERING CO., 212, *High Road, Kilburn, London*, for Gradient Indicating Blocks.

FLOWER, THOMAS JAMES MOSS, *Liverpool Chambers, Corn Street, Bristol*, for Adjustable Gradient Indicator.

FLOWER, THOMAS JAMES MOSS, *Liverpool Chambers, Corn Street, Bristol*, for Watts's Asphyxiator for Testing Drains.

HEIM, H., 41, *Holborn Viaduct, London*, for Cast and Sheet Iron Ventilating Gratings with Louvre Valves.

HEIM, H., 41, *Holborn Viaduct, London*, for Round Ventilating Valves.

EAGLE RANGE FOUNDRY COMPANY, 176, *Regent Street, London*, for Eagle Grate.

EAGLE RANGE FOUNDRY COMPANY, 176, *Regent Street, London*, for Improvements in Eagle Ranges.

REED, C. G., & SON, 26, *North Street, Brighton*, for Stoves, Mantelpieces, and Brass Work.

PETERS, BARTSCH & CO., *Derby*, for Chemical Heat Retainers.

IMPERIAL SMOKE CONSUMER CO., 63, *Borough Road, London*, for Boiler-covering Bricks.

WILSON, CHARLES, & SONS, *Leeds*, for Gas Kettle.

HAYWARD BROTHERS & ECKSTEIN, 187, *Union Street, London, S.E.*, for Mica Flap Outlet Ventilator with "Hit and Miss" Front.

HAYWARD BROTHERS & ECKSTEIN, 187, *Union Street, London, S.E.*, for Ornamental "Hit and Miss" Air Bricks.

HAYWARD BROTHERS & ECKSTEIN, 187, *Union Street, London, S.E.*, for the Southwark Universal Venetian Ventilator.

KITE, C., & Co., *Christopher Works, Chalton Street, London, N.W.*, for Wall Inlet Ventilator.

WALL, DAVID WILLIAM, 2, *Camberwell Road, London, S.E.*, for Sanitary Hat Linings.

WALKER, WALTER, *Brighton*, for Wire Mattresses and Adjustable Bed Rests.

BURROUGHS, WELLCOME & Co., *Snow Hill Buildings, London, E.C.*, for Medicine Chests and Pocket Cases.

MILLS, J., 24, *Northwood Road, Brighton*, for "Excelsior" Adjustable Invalid Chair and Couch.

BRIGDEN, J. L., & Co., 187, *Western Road, Brighton*, for "Bath" Chair.

DANN, A., *The Creamery, Western Road, Brighton*, for "Victoria" Churn.

WILLIAMS, A., 190, *Brunswick Road, Bromley, London, E.*, for Embroidery Machine.

HAINES, J., 70, *Church Road, Brighton*, for China Slop Pails.

HALLIWELL & Co., *Pool Valley, Brighton*, for Wicker Mail Cart.

HALLIWELL & Co., *Pool Valley, Brighton*, for "Harrow" Safety Bicycle.

EDMUNDS, JOSEPH, 10, *Stonefield Terrace, Liverpool Road, London, N.*, for Currie Powder and Paste.

WYBORN, EDWARD, 32, *Marine Parade, Brighton*, for Case showing the Relative Constituents of Various Milks.

THE MORRIS TUBE AMMUNITION Co., LIMITED, 11, *Haymarket, London, S.W.*, for Circulating Arrangement for Filters.

BURROUGHS, WELLCOME & Co., *Snow Hill Buildings, London, E.C.*, for Lanoline and Preparations containing it.

EDGE, H. K., 9, *Farringdon Road, London, E.C.*, for Hydroleine.

LEVER BROS., *Port Sunlight, Birkenhead*, for Sunlight Soap.

TUCKER, JOHN, & Co., 51, *Paddington Street, London, W.*, for Preparation of Eucalyptol.

BEAL, JOHN, & SON, 55, *East Street, Brighton*, for Fancy Stationery, Bindings, and Machine Ruling.

SHARP, BURT, 79, *West Street, Brighton*, for Specimens of Photography.

SELECTED FOR PRACTICAL TRIAL.

ASPINALL & Co., *New Cross and Peckham, London, S.E.*, Aspinall's Enamel.

D'OYLY & Co., LIMITED, 405, *Oxford Street, London, W.*, Wall Papers and Hangings.

OLIVER, FRANK & Co., 153, *Western Road, Brighton*, Upholstery Silks.

PETERS, BARTSCH & Co., *Derby*, Indestructible Combination Washers for Flanged Joints.

CROSSLEY BROTHERS, *Openshaw, Manchester, and* 10, *St. Bride Street, London, E.C.*, Horizontal Gas Engine.

BURGESS, HENRY JOHN, 42, *New England Road, Brighton*, High Pressure Ball Valve.

TYLOR, J., & SONS, 2, *Newgate Street, London, E.C.*, Quarter-turn Screw-down Tap.

BURGESS, HENRY JOHN, 42, *New England Road, Brighton*, High Pressure Bib Tap.

BOSTEL, D. T., 73, *Ebury Street, and* 24, *Charing Cross, London, S.W.*, Rubber Tube Ball Valve.

BOSTEL BROS., 18 *and* 19, *Duke Street, Brighton*, Professor Thompson's Water Tap.

LONDON WATER METER CO., 2, *Chancery Lane, London, E.C.*, Water Meters.

TYLOR J., & SONS, 2, *Newgate Street, London, E.C.*, Household Water Meter.

TYLOR J., & SONS, 2, *Newgate Street, London, E.C.*, Positive Water Meter.

BOSTEL BROS., 18 & 19, *Duke Street, Brighton,* Anti-Calcaire.

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TYLOR, J. & SONS, 2, *Newgate Street, London, E.C.*, Bean's Waste Preventer.

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SMEATON, JOHN, SON & Co., 50, *Gt. Queen Street*, *London*, *W.C.*, for Improved Fire Bars and Bridge.

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BARTHAM, A., *Hastings*, Delft Rye Yeast.

BUSH, J. P., *Manufacturing Co., 32, Snow Hill, London, E.C.*, Bovinine.

META-CHA TEA Co., 37, *St. Mary Axe, London, E.C.; and* 118, *St. James's Street, Brighton*, Assam Tea.

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The name of one of the Judges being prominently associated with J. TYLOR & SONS' "Clear way" Regulator Valve-closet (Mr. ROGERS FIELD'S pattern), this Exhibit has been excluded from competition for Awards.

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LIST OF HON. FELLOWS, FELLOWS, MEMBERS, AND ASSOCIATES.

(*Additions and Corrections up to December*, 1890).

Hon. Fellows,	28;	Fellows,	151;
Members,	423;	Associates,	329.—Total, 931.

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BELGIUM.

1890. June. Putzeys, Dr. Felix, *Professor of Hygiene at the University of Liège.*

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1890. June. Cornil, Dr. V., *Senator*, 19, *Rue St. Guillaume, Paris.*

1890. June. Alphand, M., *Director of Public Works, Paris.*

1890. June. Pasteur, Prof. Louis, *Paris.*

1890. June. Santa, Dr. Prosper de Piétra, *Paris.*

1890. June. Vallin, Dr. Emile, *Professor of Hygiene, Director of the School of the Military Sanitary Service, Lyons.*

1890. June. Davy, Mariè, *President of the French Society of Hygiene.*

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HOLLAND.

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1890. June. Guillaume, Dr., *Director of the Federal Bureau of Statistics, Berne.*

TURKEY.

1890. June. Zoëros, A., Pasha, *Professor at the School of Medicine, Director of the Bacteriological Institute, Secretary-General of the Administration of Public Medicine and Hygiene, Constantinople.*

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1890. June. Bowditch, Dr. Henry J., *Boston.*
1890. June. Walcott, Dr. Henry P., *Cambridge, Massachusetts.*

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† Marked thus have passed the Examination of the Institute for Local Surveyors.

‡ Marked thus have passed the Examination of the Institute for Inspectors of Nuisances.

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1889. Nov. Anson, Frederick Henry, M.A., ASSOC.M.INST.C.E., 15, *Dean's Yard, Westminster, S.W.*

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1888. Oct. Baker, R., *Ballingdon House, Green Lanes, N.*
1888. Oct. Banner, E. G., *Wessex House, Northumberland Avenue, W.C.*
1890. May. Barton, John Isaac, *Ryde, (Ventnor), Isle of Wight.*
1890. May. Bateman, James, *Assistant Engineer, Natal Government Railway.*
1888. Oct. Bathurst, the Rt. Hon. the Earl, 20, *Grosvenor Gardens, S.W.*
1888. Oct. Baugh, Alfred C., *Egerton Street, Wrexham.*
1888. Oct. Bean, Alexander Thomas, 7, *Victoria Street, S.W.*
1888. Dec. †Beard, E. T., *The Colonial College, Hollesley Bay, Suffolk.*
1888. Oct. Beard, George, *Thickthorn, Kenilworth.*
1888. Oct. Beard, Neville, *The Mount, Ashbourne.*
1889. Dec. Beardmore, George Russell, L.R.C.P.LOND., M.R.C.S., L.S.A., D.P.H.CAMB., *Warwick House, Upper Street, Islington.*
1888. Oct. Beck, Marcus, M.B., 30, *Wimpole Street, W.*
1888. Oct. Beddoe, John, B.A., M.D., F.R.S., *Mortimer House, Clifton, Bristol.*
1888. Oct. Beevor, Mrs. Elizabeth, 129, *Harley Street, W.*
1888. Oct. Bell, Thomas, L.R.C.P. LOND., *Uppingham, Rutland.*
1888. Dec. ‡Benjamin, Horace Bernton, F.R.G.S., 28, *Albemarle Street, W.*, (37, *Upper Grosvenor Street, W.*).
1888. Oct. Bennett, Hugh, M.R.C.S., *Builth Wells, Brecon.*
1888. Oct. Bernard, William Larkins, 39, *Broad Street, Bristol.*
1888. Oct. †Berrington, R. E. W., ASSOC.M.INST.C.E., *Graiseley, Wolverhampton.*
1888. Oct. Bickersteth, E. R., F.R.C.S., 2, *Rodney Street, Liverpool.*
1888. Oct. Black, Surg.-Major W. G., 2, *George Square, Edinburgh.*
1889. Mar. Blair, William Nisbet, ASSOC.M.INST.C.E., *Town Hall, Bootle-cum-Linacre.*
1888. Oct. Blashill, T., F.R.I.B.A., *Superintending Architect, London County Council, Spring Gardens, S.W.*
1889. Nov. Bleksley, Arthur Herbert, J.P., *Borough of Kimberley, Griqualand West, Cape Colony.*
1889. Mar. Blumer, Frederick Milnes, B.A., M.B., M.O.H., *Foregate Street, Stafford.*
1889. Feb. Bolding, John T., 19, *South Moulton Street, W.*
1888. Oct. Bond, Frederick Adolphus, M.B., C.M.EDIN., D.P.H.EDIN., *Seerscroft, Faygate, Sussex.*
1890. Apr. Boobbyer, Philip, M.B., M.R.C.S., M.O.H., *The Guildhall, Nottingham.*

1888. Dec. Bostock, H., *The Oaklands, Rowley Avenue, Stafford.*
1888. Oct. Box, M. H.
1888. Oct. Brace, W. H., M.D., 7, *Queen's Gate Terrace, S.W.*
1888. Oct. Brackett, Wm., 42, *London Road, and* 27, *High Street, Tunbridge Wells.*
1888. Oct. Bradshaw, James D., B.A., M.B., M.R.C.P., M.R.C.S., 30, *George Street, Hanover Square, W.*
1889. Mar. Brebner, George Reith, M.D., D.P.H., *Bensham Lodge, West Croydon.*
1888. Oct. Bridges, J. H., M.B., F.R.C.P., *The Brambles, Wimbledon.*
1888. Nov. Bristowe, John Syer, M.D., F.R.S., 13, *Old Burlington Street, W.*
1889. Apr. Brodie, John Shanks, ASSOC.M.INST.C.E., *Town Hall, Whitehaven, Cumberland.*
1889. Mar. Brooke, Walter, ASSOC. M. INST. C. E., *Town Surveyor, Richmond, Surrey.*
1889. Apr. Brooke, William, M.D., M.O.H., *Shaw, near Oldham.*
1888. Oct. Brown, William Ibbs, *St. Michael's Avenue and Guildhall, Northampton.*
1888. Oct. Bryant, Thomas, F.R.C.S., 65, *Grosvenor Street, W.*
1888. Dec. Buckton, Mrs. 27, *Ladbroke Square, W.*
1888. Dec. †Bunten, Charles, *Casilla*, 448, *c/o L. J. Lowe, Calle Rividaira* 165, *Buenos Ayres.*
1890. Apr. Burdwood, James Watson, M.O.H., Bourne, *West Cottage, Bourne, Lincoln.*
1888. Dec. Burmester, Miss E., 9, *Park Square, W.*
1890. Jan. Burr, Alfred, F.R.I.B.A., 85, *Gower Street, W.C.*
1889. Apr. Burton, Samuel Hubert, F.R.C.S., M.O.H., 50, *St. Giles's Street, Norwich.*
1889. Jan. †Burton, W. Kinninmond, *Professor of Sanitary Engineering, Imperial University, Tokio, Japan.*
1889. Feb. †Campbell, Adam Horsburgh, ASSOC.M.INST.C.E., *Borough Surveyor's Office, Stratford-on-Avon.*
1888. Oct. Campbell, Charles, *Neepsend, Sheffield.*
1888. Oct. Campbell, Hon. Dudley, 1, *Mitre Court Buildings, Temple.*
1889. Mar. Campbell, Kenneth Findlater, ASSOC. M. INST. C. E., *Borough Engineer, Stockton-on-Tees.*
1888. Oct. Carline, John, ASSOC.M.INST.C.E., *Lewisham Board of Works, S.E.*
1889. Mar. Carlton, George Brody, ASSOC.M.INST.C.E., *Knighton, Oak Hill Road, Beckenham.*
1888. Nov. Carritt, Ernest, 18 *&* 19, *Great St. Helens, E.C.*
1890. Nov. Chart, Robert Masters, *Mitcham, Surrey.*
1888. Oct. Chatterton, George, M.INST.C.E., 46, *Queen Anne's Gate, S.W.*
1888. Oct. Chattock, Miss Frances C., *Solihull, Birmingham.*

1888. Oct. CLARKE, James Wright, 17, *Shelgate Road, Northcote Road, Wandsworth.*
1888. Oct. CLARKSON, J. W., M.R.C.S.E., L.R.C.P.L., *c/o Messrs. H. S. King & Co., Pall Mall, S.W.*
1890. Oct. †CLOTHIER, Samuel Thompson, *Street, Somerset.*
1888. Oct. COATES, C., F.R.C.P., 10, *Circus, Bath.*
1888. Oct. COCK, Frederick, M.D., 1, *Porchester Houses, Porchester Square.*
1888. Oct. COKE, William Harriott, M.R.C.S., *Whitfield House, Ashford, Kent.*
1888. Oct. COLLINGRIDGE, W., M.A., M.D., D.P.H., *Port of London Sanitary Offices, Greenwich, S.E.*
1888. Oct. COLLINSON, John, 90, *Cromwell Road, S.W.*
1888. Oct. †COMBER, P. F., M.INST.C.E. IRELAND, *Fairy Hill, Bray, Co. Wicklow.*
1888. Oct. †COOPER, C. H., ASSOC.M.INST.C.E., *Local Board Offices, Wimbledon.*
1888. Oct. COOPER, Francis A., ASSOC.M.INST.C.E., *c/o H. F. Cooper, Nottingham and Notts Bank, Newark.*
1888. Oct. COOPER, Henry W., 27, *Upper George Street, Edgware Road, W.*
1888. Nov. COOPER, John, jun., *Croydon.*
1889. Jan. †COOPER, William, 32, *Cheetham Street, Cheetham, Manchester.*
1888. Oct. CORBETT, Joseph, 9, *Albert Square, Manchester.*
1888. Oct. CORSAN, John R., 80, *Gray's Inn Road, W.C.*
1888. Oct. COURTNEY, MAJOR D. C., R.E., 22, *Collingham Gardens, Kensington, S.W.*
1889. Oct. COWAN, Peter Chalmers, B.SC. (EDIN.), ASSOC.M.INST.C.E., 9, *College Gardens, Belfast.*
1888. Oct. COWTAN, Frank, 309, *Oxford Street, W.*
1890. Oct. †‡CRAIG, G. A., *Wood's Temperance Hotel, High Street, Berwick-on-Tweed.*
1888. Oct. CRANBROOK, THE RT. HON. VISCOUNT, G.C.S.I., 17, *Grosvenor Crescent, S.W.*
1889. June. CREGEEN, Hugh Stowell, 42, *Freelands Road, Bromley, Kent.*
1888. Oct. †CRIMP, W. Santo, ASSOC.M.INST.C.E., F.G.S., *London County Council, Spring Gardens.*
1888. Oct. CROMBIE, James, M.B., D.P.H.EDIN., *The Butts, Brentford.*
1888. Oct. CROWLEY, Frederick, *Ashdell, Alton, Hants.*
1889. Mar. CUFF, Robert, M.B., M.R.C.S., M.O.H., 28, *Huntriss Row, Scarborough.*
1888. Oct. CUNNINGHAM, SIR H. S., K.C.I.E., 11, *Egerton Gardens, S.W.*
1888. Oct. †CURWEN, John F., 51, *Highgate, Kendal.*
1890. Mar. DABBS, George Henry Roque, M.D., M.R.C.S., M.O.H., *Highfields, Shanklin, I. of Wight.*

1888. Oct. †DARCH, John, 74, *Sarsfield Road, Balham, S.W.*
1890. Oct. †DAVIS, Neville Brookes, 32, *Ashburnham Road, Bedford.*
1888. Oct. DAWSON, Charles James, *Surveyor to the Local Board Barking.*
1888. Oct. DAY, Ernest, F.R.I.B.A., 5, *Foregate Street, Worcester.*
1890. Nov. DAY, William White, M.D., D.P.H.CAMB., *Church Street Lower Edmonton.*
1888. Oct. DEBENHAM, F. G., *Cheshunt Park, Herts.*
1888. Oct. DE CHAUMONT, Miss Anna Kennedy Francois, *Alladale, Woolston, Southampton.*
1889. Nov. DE COURCY-MEADE, Thomas, ASSOC.M.INST.C.E., 1, *Park Villas, The Park, Highgate, N.*
1888. Oct. DE SOLDENHOFF, Richard, 12, *Newport Road, Cardiff.*
1888. Oct. DENNIS, Nelson F., *Town Surveyor, West Cowes.*
1889. May. DIXEY, Harry Edward, M.D., *Woodgate, Great Malvern.*
1889. Apr. DONALD, James Turner, L.R.C.S., M.O.H., *Paisley.*
1889. Apr. DONOVAN, Dennis D., L.R.C.P., L.R.C.S., *Superintendent Medical Officer of Health, City of Cork.*
1888. Oct. DOUGLAS, George, *Burslem.*
1888. Oct. DOULTON, James Duncan, *Lambeth.*
1890. Jan. DRUMMOND, Edward, M.D., M.R.C.S., D.P.H.CAMB., *Rome.*
1888. Dec. DRURY, Edward Dru., F.S.A., F.R.I.B.A., 35, *Bucklersbury, E.C.*
1889. Nov. DUNLOP, Archibald, M.D., M.R.C.S., M.O.H., *Holywood, Belfast.*
1889. Apr. EATON-SHORE, George, ASSOC.M.INST.C.E., *Borough Engineer*, 190, *Edlestone Road, Crewe.*
1888. Oct. EBURY, RT. HON. LORD, *Moor Park, Rickmansworth.*
1888. Oct. ECCLES, Miss Jane Helen, 3, *Dean's Yard, Westminster, S.W.*
1888. Oct. ELFORD, John, *Borough Surveyor, Poole, Dorset.*
1888. Dec. EMERSON, W., F.R.I.B.A., 8, *The Sanctuary, S.W.*
1889. May. ENGLISH, Edgar, M.R.C.S., L.S.A., D.P.H., *High Street, Mexborough, Rotherham.*
1889. Jan. ERICHSEN, J. Eric, F.R.S., 6, *Cavendish Place, W.*
1888. Nov. EVERS, SURG.-MAJOR B., *care of Messrs. Watson Bros.*, 27, *Leadenhall Street, E.C.*
1889. Jan. FARRER, SIR T. H., BART., 27, *Bryanston Square, W.*
1888. Oct. FAWCETT, William Milner, M.A., F.R.I.B.A., 1, *Silver Street, Cambridge.*
1888. Oct. FERNIE, C. W. B., *Keythorpe, Leicester.*
1888. Oct. FIELD, Horace, 14, *Gray's Inn Square, W.C.*
1888. Oct. FINLAY, David W., B.A., M.D., F.R.C.P., D.P.H.CAMB., 9, *Lower Berkeley Street, W.*
1888. Oct. FISHER, T. J., 50, *Thorne Road, South Lambeth.*
1888. Oct. FORDE, H. C., M.INST.C.E., 4, *Great Winchester St., E.C.*
1888. Oct. FOSTER, Reginald Le Neve, F.C.S., *North Road, Droylsdon, Manchester.*

1888. Oct. Frank, Philip, M.D., *Cannes, France.*
1888. Oct. Fraser, James, M.INST.C.E., 100, *Castle Street, Inverness.*
1889. Jan. Fraser, W. J., ASSOC.M.INST.C.E., 98, *Commercial Road, E.*
1888. Nov. Fryer, James, 13, *Bloomsbury Street, Vincent Square, S.W.*
1888. Oct. Galton, Francis, F.R.S., 42, *Rutland Gate, S.W.*
1889. Mar. Gange, Frederick A., M.D., M.O.H., *Faversham, Kent.*
1888. Oct. †Geen, Harry, *Hillside, Okehampton, Devon.*
1889. June. Gibson, Charles Philip, L.R.C.P., M.R.C.S., M.O.H., *Wetherby, Yorkshire.*
1889. Dec. †Gibson, William, *Bonhay Road, Exeter.*
1889. Jan. †Gilby, Charles, *Bath.*
1888. Oct. Gill, D., *Farleigh, Weston-super-Mare.*
1888. Dec. Gladstone, J. H., PH.D., F.R.S., 17, *Pembridge Square, W.*
1888. Dec. Glen, A. W., 33, *Davies Street, Berkeley Square, W.*
1890. Mar. Godfrey, Robert, ASSOC.M.INST.C.E., *King's Heath, Worcestershire.*
1889. Nov. Goodyear, Herbert, ASSOC.M.INST.C.E., *Colchester, Essex.*
1889. June. Goude, Herbert, M.D., D.P.H., *Small-pox and Vaccination Hospital, Highgate Hill, Upper Holloway, N.*
1889. Apr. Grant, Ogilvie, M.B., C.M.EDIN., M.O.H., *Queen Mary's House, Inverness.*
1888. Oct. Gray, Alexander, 25, *Greenhill Road, Hampstead, N.W.*
1890. Apr. Greatorex, Albert Daniel, *Municipal Offices, Southampton.*
1888. Oct. Grellier, William, F.R.I.B.A., 6, *Queen Anne's Gate, S.W.*
1888. Oct. Groves, Joseph, B.A., M.D., F.G.S., *Carisbrooke, Isle of Wight.*
1890. Jan. Gruggen, William, D.P.H., 11, *Montpelier Road, Ealing, W.*
1888. Oct. Hall, E. T., F.R.I.B.A., 57, *Moorgate Street, E.C.*
1888. Oct. Hancock, Charles, M.A.OXON, 2, *The Cloisters, Temple, E.C., and Reform Club, S.W.*
1890. Dec. Hanson, John, *Victoria Chemical Works, Wakefield.*
1889. Apr. Hardie, Gordon K., M.D., *Florence Road, Ealing.*
1889. Mar. Harding, J. R., ASSOC.M.INST.C.E., *Surveyor, Epsom, Surrey.*
1889. Apr. Hare, C. J., M.D., F.R.C.P., *Berkeley House*, 15, *Manchester Square, W.*
1889. Mar. Harpur, William, M.INST.C.E., *Town Hall, and* 197, *Severn Road, Cardiff.*
1890. Apr. Harris, Arthur Wellesley, M.R.C.S., L.S.A., D.P.H., M.O.H., *High Street, Southampton.*
1888. Oct. Harris, William John, M.R.C.S.E., L.S.A., F.R.MET.SOC., *Church House, Heene, Worthing.*

1888. Oct. HARRISSON, Thomas Harnett, ASSOC.M.INST.C.E., *Central Buildings, North John Street, Liverpool.*
1888. Dec. HARROLD, Miss C., 10, *Church Road, Edgbaston, Birmingham.*
1888. Oct. HASLAM, Lewis, *Ravenswood, near Bolton.*
1889. Nov. HASTINGS, George Woodyatt, M.P., *Barnards Green House, Nr. Malvern.*
1888. Oct. HAYWARD, C. F., F.S.A., F.R.I.B.A., 47, *Museum Street, Bloomsbury, W.C.*
1888. Oct. HEAD, Henry, 41, *Wimpole Street, W.*
1889. Feb. HEAD, Mrs. H., 41, *Wimpole Street, W.*
1888. Oct. HELLYER, S. Stevens, 21, *Newcastle Street, Strand, W.C.*
1889. Mar. HERBERT, Johnson, L.R.C.P., 7, *Abbey Terrace, West Cliff, Whitby.*
1889. Jan. HILL, Pearson, 6, *Pembridge Square, W.*
1888. Oct. HILL, Samuel, A.R.I.B.A., 16, *Russell Square, W.C.*
1888. Oct. HILL, William H., *Town Hall, Kensington.*
1888. Dec. HILL, Miss F. M. Davenport, 25, *Belsize Avenue, N.W.*
1888. Dec. HILL, Miss R. Davenport, 25, *Belsize Avenue, N.W.*
1889. Mar. HODGETTS, E. A. Brayley, 39, *Redcliffe Square, South Kensington, S.W.*
1888. Oct. HODGSON, Shadworth H., 45, *Conduit Street, W.*
1890. Apr. HOLBERTON, Henry Nelson, L.R.C.P., M.R.C.S., D.P.H., *East Moulsey.*
1888. Oct. HOLMES, Timothy, M.A., F.R.C.S., 18, *Great Cumberland Place, W.*
1888. Oct. HOLT, H. P., ASSOC.M.INST.C.E., F.G.S., *The Cedars, Didsbury, Manchester.*
1889. Mar. HOOLEY, Cosmo C., ASSOC.M.INST.C.E., *The Union Offices, Barton-upon-Irwell, Manchester.*
1889. Nov. HOOPER, Charles, M.R.C.S., M.O.H., *Aylesbury, Bucks.*
1889. Jan. †‡HOUGHTON, John, *Poplar Road, King's Heath, near Birmingham.*
1888. Oct. HOWARD, E., 84, *Upper Whitecross Street, E.C.*
1888. Oct. HOWE, George, 41, *Wigmore Street, W.*
1890. June. ‡HOY, Peter, 2, *Dudley Place, W.*
1888. Oct. †HUBBER, Frank, 85, *South Street, Exeter.*
1888. Dec. INGLIS, Cornelius, M.D., 1, *Albert Mansions, Victoria Street, S.W.*
1890. May. IVOR-MOORE, T., *R. E. Establishment, Barbadoes, West Indies.*
1890. Nov. †JAMES, Arthur Charles, *Assist.-Surveyor, Borough Surveyor's Office, Cambridge.*
1889. May. JAMES, Charles Alfred, L.R.C.P, M.R.C.S., D.P.H., 24, *Cazenove Road, Stamford Hill, N.*
1890. Jan. JONES, Frederick Felix, M.O.H., *Llanfyllm, Montgomery.*
1888. Oct. JONES, John Watkin, *Maesyffynon, Tonalaw, near Pont-y-pridd, South Wales.*

1889. May. Jowett, William, *Lower Hall, Mellor, Stockport.*
1889. Apr. Keep, Claude Charles, *York House, Handsworth, Birmingham.*
1889. Mar. Kempster, William Henry, M.D., M.O.H., *Oak House, Battersea.*
1888. Oct. Kennett-Barrington, Sir Vincent Hunter B., 65, *Albert Hall Mansions, Kensington Gore, S.W.*
1889. Jan. Kinsey, W. Barns, M.INST.C.E., F.G.S., *Park House, Lennard Road, Croydon.*
1889. Mar. Kinsey-Morgan, A., M.R.C.S., L.S.A., M.O.H., *Bournemouth.*
1889. Dec. Kirby, Oscar John, *Engineer and Manager Water Works, Batley.*
1889. Mar. Kirwan, Surgeon-Major A., D.P.H., *Colwyn, Cargate Avenue, Aldershot.*
1889. Mar. Kyle, Thomas W., M.D., D.P.H., M.O.H., *Measham, Atherstone.*
1888. Oct. Lacy, William George, 24, *Ringford Road, West Hill, Wandsworth.*
1889. May. Laing, R., M.R.C.S., L.R.C.P., F.R.MET.SOC., M.O.H., 29, *Waterloo Road, Blyth, Northumberland.*
1888. Dec. Lavender, Charles Henry Nalder, 2, *Ulster Terrace, Regent's Park, N.W.*
1888. Oct. Lawrence, Edwin, 10, *Kensington Palace Gardens, W.*
1888. Oct. Le Grand, A., 100, *Bunhill Row, E.C.*
1888. Oct. Lemon, James, M.INST.C.E., F.R.I.B.A., F.S.I., F.G.S., *Lansdowne House, Southampton, (Palace Chambers, Westminster).*
1888. Oct. Leonard, Hugh, 7, *Hanover Square, W.*
1888. Oct. Le Rosignol, Francis, F.S.I., 1, *Gresham Buildings, Basinghall Street, E.C.*, (29, *Penn Road Villas, Camden Road, N.*).
1889. June. Letts, Thomas Hollins, 185, *Earls Court Road, South Kensington.*
1888. Oct. Lingard, Alfred, M.R.C.S., L.S.A., D.P.H.CAMB., *St. Ermins Mansions, Westminster.*
1888. Oct. Lingard, J. Edward, ASSOC.M.INST.C.E., *Rodney Chambers, Derby.*
1888. Oct. Lloyd, Robert Samuel, 84 & 85, *Whitecross St., E.C.*
1888. Oct. Lloyd, Thomas, *The Square, Winchester.*
1890. Mar. Loane, Joseph, M.R.C.P.E., D.P.H., M.O.H., 98, *Tressillian Road, St. John's, S.E.*
1889. Apr. Lockwood, Phillip Causton, M.INST.C.E., 1, *Gloucester Place, Brighton.*
1889. Jan. Lowe, Mrs. Thomas, *Solihull, Birmingham.*
1888. Oct. Lyon, Washington, 85, *Asylum Road, Peckham, S.E.*
1888. Dec. McArthur, A., M.P., 79, *Holland Park, W.*
1890. Oct. McBeath, William, M.A., M.D., D.P.H., *New Swindon, Wilts.*

1888. Oct. Macassey, L. Livingston, m.inst.c.e., 1, *Elm Court, Temple, E.C.*
1888. Oct. McIntosh, James, *Duneevan, Oatlands Park, Weybridge.*
1888. Oct. ‡Mackenzie, F. Morell, m.r.c.s., l.s.a., 10, *Hans Place, S.W.*
1888. Oct. Mackey, John B., 2, *Bouverie Street, Fleet Street, E.C.*
1888. Oct. McKie, Hugh Umsworth, assoc.m.inst.c.e., 111, *Palace Chambers*, 9, *Bridge Street, Westminster.*
1888. Oct. Maclagan, James McGrigor, m.d., *Riding-Mill-on-Tyne, Northumberland.*
1889. Jan. McLean, Surgeon-Gen. W. Campbell, c.b., m.d., *Army Medical School, Netley.*
1888. Oct. McMorran, Alexander, *Galloway House, Carlton Road, Putney.*
1890. Apr. McNeill, Roger, m.d., d.p.h., j.p., *Gesto Hospital, Edinbane, Isle of Skye, Inverness.*
1889. Mar. Macnamara, Charles Edward, l.k.q.c.p.i., d.p.h., 11, *Cambridge Gardens, Notting Hill, W.*
1888. Oct. †Maguire, William Robert, f.r.met.soc., 10, *Dawson Street, Dublin, and Town Hill, Dalkey, Co. Dublin.*
1888. Oct. Maltby, Frederic Thomas, assoc.m.inst.c.e., *Borough Engineer, Dorchester.*
1890. July. Marsden, James Aspinall, m.r.c.s., l.s.a., d.p.h., m.o.h., *Standish, Wigan, Lancashire.*
1888. Dec. Marshall, John Ingham F., m.r.c.s., 28, *St. Saviourgate, York.*
1888. Dec. Martindale, William, 10, *New Cavendish Street, W.*
1888. Oct. Martineau, E. H., f.r.i.b.a., 30, *Weymouth Street, Portland Place, W.*
1888. Oct. Mason, Hugh H., m.r.c.s., *Abbey Lodge, Barking.*
1889. Nov. ‡†Massey, Joseph Bennett, 64, *Burns Street, Burnley, Lancaster.*
1888. Oct. Mathews, J. Douglass, f.r.i.b.a., f.s.i., 11, *Dowgate Hill, E.C.*
1888. Oct. †Mawbey, E. G., assoc.m.inst.c.e., *Borough Engineer and Surveyer, Town Hall, Leicester.*
1888. Oct. Melissenos, G. C. A. Melisurgo, assoc.m.inst.c.e., *Palazzo Cocozzo*, 76, *Via Poerio, Naples.*
1888. Oct. †Metcalf, John W., *Ravenstone, Ashby-de-la-Zouch.*
1888. Oct. Middleton, Reginald E., m.inst.c.e., m.i.m.e., 49, *Parliament Street, S.W.*
1888. Oct. Mineard, George Edward, f.r.h.s., 70, *Philbeach Gardens, Earl's Court, S.W.*
1888. Oct. Mocatta, F. D., 9, *Connaught Place, W.*
1888. Oct. Montagu, Samuel, 12, *Kensington Palace Gardens, W.*
1888. Oct. Moore, J. H., *St. Michael's Lodge, Bournemouth.*
1890. Mar. Morgan, William Pringle, b.a., m.b., b.ch., d.p.h., *Hardis House, Seaford.*
1889. July. Morison, John, m.d., d.p.h., *Victoria Street, St. Albans.*

1888. Oct. †Morley, J. G., assoc.m.inst.c.e., *Town Hall, Stratford, E.*
1889. May. Morris, Pryce Jones Langford, m.r.c.s., l.r.c.p., m.o.h., *Halesworth, Suffolk.*
1888. Oct. Moseley, George, f.r.c.s., 27, *Willbury Road, Hove, Brighton.*
1888. Oct. Mouat, F. J., m.d., 12, *Durham Villas, Kensington, W.*
1888. Oct. Mouat, Surgeon-General J., c.b., f.r.c.s., 108, *Palace Gardens Terrace, W.*
1888. Oct. Mumby, B. H., m.d., m.r.c.s., m.o.h., *Portsmouth.*
1889. Apr. Munce, James, assoc.m.inst.c.e., *Town Hall, Belfast.*
1889. Dec. Munday, Major Henry, 23, *Oakley Square, N.W.*
1889. Apr. Murphy, Francis Henry Swinton, m.d., d.p.h., *The Army Medical Department, Belmont, Queenstown.*
1889. Jan. Myers, Brigade-Surgeon A. B. R., m.r.c.s., l.s.a.
1888. Oct. Nanson, Tom, 9, *Park Crescent, Stockwell Park Road, S.W.*
1888. Nov. Nash, Brigade-Surgeon William, m.d., 18, *Victoria Street, Westmister, S.W.*
1889. May. Nasmyth, Thomas Goodall, m.b., c.m., d.p.h., f.r.s.e., *Cowdenbeath, Fife.*
1889. Mar. Nelson, E. M., *Hanger Hill House, Ealing.*
1888. Oct. Nelson, George H., *The Lawn, Warwick.*
1888. Oct. Newton, Edward, f.r.c.s., 85, *Gloucester Place, Hyde Park, W.*
1888. Oct. Nicol, W. E., *Ballogie, Aboyne, Aberdeen.*
1888. Oct. †Nichols, H. Bertram, assoc.m.inst.c.e., *Grosvenor Chambers, Corporation Street, Birmingham.*
1890. Dec. Nunn, F. C., assoc.m.inst.c.e., *Eastnor, Sydenham Hill, Surrey.*
1888. Oct. Page, Herbert Markant, m.d., d.p.h.camb., m.r.c.s., 16, *Prospect Hill, Redditch.*
1888. Dec. Paget, G. E., m.a., 3, *Sunderland Terrace, Westbourne Park, W.*
1888. Oct. Pagliardini, T., 21, *Alexander Street, Westbourne Park, W.*
1889. May. Parker, G. R., m.r.c.s., l.r.c.p., m.o.h., 34, *King Street, Lancaster.*
1889. Mar. Parker, John, assoc.m.inst.c.e., 42, *Dryden Street, Nottingham.*
1890. Mar. †Parker, John, assoc.m.inst.c.e., *City Engineer, Hereford.*
1888. Oct. Parkes, Miss P., 8, *Grove Road, Surbiton, S.W.*
1888. Oct. Parsons, H. Franklin, m.d., *Local Government Board, Whitehall, S.W.*
1889. Mar. Partridge, Thomas, m.r.c.p.i., m.k.q.c.s.i., l.s.a., m.o.h., *Stroud, Gloucester.*
1889. May. Patten, Charles Arthur, l.r.c.p., m.o.h., *Ealing.*

1888. Oct. Pattinson, S., *Ruskington, Sleaford, Lincoln.*
1888. Dec. Peake, Francis, *The Waldrons, Croydon.*
1888. Dec. Peel, Edmund, *Brynfys, Ruabon, North Wales.*
1888. Oct. †Phillipson, Burton R., *Baggot Street, Dublin.*
1890. Oct. †‡Poggio, Eloi John, 20, *Marylands Road, Harrow Road, W.*
1888. Oct. Powell, George Thompson, *Rotherwood, Sydenham Hill*, (28 *and* 29, *St. Swithin's Lane, E.C.*).
1888. Oct. Powell, J., 10, *St. George's Crescent, Liverpool.*
1888. Dec. Priestly, Mrs. Eliza, 17, *Hertford Street, Mayfair.*
1888. Oct. Pritchett, G. E., F.S.A., F.R.I.B.A., *Oak Hall, Bishop's Stortford*, (1, *Hanway Place, Oxford Street, W.*).
1888. Oct. Pullar, Robert, J.P., F.R.S.E., *Tayside, Perth.*
1888. Oct. Pullin, T. H. S., M.D., F.R.C.S., F.S.A., *Sidmouth, Devon.*
1888. Oct. Purnell, W. J., *Vincent Row, Vincent Street, Westminster.*
1888. Oct. Purnell, E. W., *Vincent Row, Vincent Street, S.W.*
1888. Oct. Quain, R., M.D., F.R.S., 67, *Harley Street, W.*
1889. Nov. †‡Radcliffe, Joseph, F.R.MET.SOC., *The Waterworks, Todmorden, Lancaster.*
1890. Nov. Radford, John Charles, ASSOC.M.INST.C.E., *Surveyor*, 113, *High Street, Putney.*
1888. Oct. †Radford, W. H., ASSOC.M.INST.C.E., A.R.I.B.A., *Pelham Chambers, Angel Row, Nottingham.*
1889. Mar. †Railton, James, *Town Hall, Lower Edmonton.*
1890. Apr. Rainger, Charles Henry, 9, *Bath Place, Cheltenham.*
1889. Mar. Read, Richard, ASSOC. M. INST. C. E., *City Surveyor, Gloucester.*
1890. Nov. Reid, George, M.D., D.P.H., M.O.H., *St. Mary's Grove, Stafford.*
1888. Nov. Reynolds, Mrs. Russell, 38, *Grosvenor Street, W.*
1890. Mar. Rhodes, John William, 3, *Clifford's Inn, Fleet Street, E.C.*
1888. Oct. Ridings, H. Sadleir, M.A., M.INST.C.E., *Town Hall, Walthamstow.*
1888. Oct. Roberts, Frederick F., M.D., 102, *Harley Street, W.*
1890. Jan. Roberts, Richard Lawton, M.D., D.P.H.CAMB., M.R.C.S., L.S.A., *Ruabon, North Wales.*
1888. Dec. Robins, Edward, 105, *Regent Street, W.*
1888. Dec. Roe, Surgeon-Major, E. A. H., 17, *Whitehall Place, S.W.*
1889. Apr. Rogers, George Arthur, M.R.C.S.E., L.S.A., M.O.H., 404, *Commercial Road, E.*
1888. Oct. Roth, W. M.D., 6, *Kaizer Wilhelm Platz, Dresden, N.*
1888. Oct. Russell, Right Hon. Lady Agatha, *Pembroke Lodge, Richmond Park, Surrey.*
1889. Mar. Sandell, Henry W. Adrian, M.R.C.S., M.O.H., *Leighton Buzzard.*

1889. Mar. Schofield, Gerald, M.R.C.S., L.R.C.P., D.P.H., *Durham House, Bournemouth.*
1888. Oct. Scott, Bowes, *Broadway Chambers, S.W.*
1889. Mar. Scott, Hugh Hamilton, ASSOC.M.INST.C.E., *Town Hall, Hove, Brighton.*
1888. Oct. Scott-Moncrieff, W. D., M.I.M.E., 86, *Newman Street, W.*
1888. Oct. Scriven, J. Barclay, M.R.C.S., 95, *Oxford Gardens, North Kensington.*
1888. Dec. Searles-Wood, Herbert D., F.R.I.B.A., 157, *Wool Exchange, E.C.*
1889. Jan. Selby, Prideaux, *Koroit, North Park, Croydon.*
1889. Mar. Sellers, William, Junr., M.D., M.O.H., *Bank House, Radcliffe, Manchester.*
1889. Mar. Shadwell, St. Clair B., L.R.C.P., M.R.C.S., M.O.H., *Lynhurst, Walthamstow.*
1889. Mar. Shaw, Charles Knox, L.R.C.P., M.R.C.S., M.O.H., 2, *Pevensey Road, St. Leonards-on-Sea.*
1889. Apr. Shaw, Josephus, M.R.C.S., L.S.A., M.O.H., 151, *Lower Road, Rotherhithe.*
1889. Mar. Shirtliff, Edward Matthew, M.D., M.O.H., *Elm Side, Kingston-on-Thames.*
1889. Jan. Shone, Isaac, *Gt. George Street Chambers, S.W.*
1888. Oct. Shonksmith, John Henry, *Micklegate, York.*
1888. Oct. Sillar, W. C., *St. James' Lodge, Kidbrooke Park Road, Blackheath, S.E.*
1888. Dec. Simpson, William John, M.D., D.P.H.CAMB., *Health Officer, Calcutta.*
1888. Oct. Siordet, James Lewis, M.B., F.R.C.P., *Mentone, Alpes-Maritimes, France.*
1888. Oct. Skrine, Henry Duncan, *Claverton Manor, Bath.*
1888. Oct. Smeaton, J., 56, *Great Queen Street, Lincoln's Inn Fields, W.C.*
1889. June.‡†Smith, Charles Chambers, *Union Offices, Gargrave Road, Skipton, Yorkshire.*
1888. Oct. Smith, Percival Gordon, F.R.I.B.A., *Highfield, Stonebridge Park, Willesden.*
1888. Oct. Smith, R. W., *Mount Rundell, Harborne, Birmingham.*
1888. Oct. Smith, Thos. Fredk. H., F.R.C.S., L.S.A., *Farningham, Kent.*
1889. Feb. Smith, T. V., 111, *Grosvenor Road, S.W.*
1889. Mar. Smith, William Howard, ASSOC.M.INST.C.E., *City Surveyor, Carlisle.*
1889. Jan. Snell, Alfred, W., A.R.I.B.A., 1, *Park Road, Wimbledon.*
1889. Apr. Southam, Arthur, ASSOC.M.INST.C.E., 60, *Old Town, Clapham.*
1889. Mar. Squance, Thomas Coke, M.D., F.R.MET.SOC., M.O.H., 4, *Beauclerc Terrace, Sunderland.*

1888. Oct. Stainthorpe, W. Waters, m.d., d.p.h.edin., *Kirkleatham, Redcar.*
1888. Oct. Stansfield-Brun, J., assoc.m.inst.c.e., f.r.i.b.a., *District Surveyor, Bradford-on-Avon.*
1889. Jan. Steavenson, W. E., m.d., d.p.h., 15, *Mansfield Street, Portland Place, W.*
1889. Apr. Steel, William D., m.d., m.o.h., d.p.h., *Neville Street, Abergavenny.*
1889. Mar. Steeves, George Walter, b.a., m.d., m.o.h., 53, *Parkfield Road, Liverpool.*
1888. Oct. Stephenson, J. Gurdon L., assoc.m.inst.c.e., m.i.m.e., f.g.s., 6, *Drapers Gardens, E.C., and* 14, *Maxilla Gardens, Notting Hill, W.*
1890. Oct. Stevens, Joseph Wallace, *Belph, Whitwell, near Chesterfield.*
1888. Oct. Stevenson, Thos., m.d., 45, *Gresham Road, S.W.*
1889. Mar. Stewart, Alan, *Maldon, Essex.*
1889. Jan. Stiff, Ebenezer, *London Pottery, Lambeth.*
1890. Mar. Stirling, Alex. W., m.d., m.o.h., *Shaftesbury House, Grays, Essex.*
1888. Oct. Stone, W. H., *Lea Park, Godalming.*
1888. Oct. Street, William C., a.r.i.b.a., assoc.inst.c.e., 7, *Victoria Street, Westminster, S.W.*
1888. Dec. Sudeley, Right Hon. Lord, 7, *Buckingham Gate, S.W.*
1889. Jan. †Swainson, John Henry, m.s.a., assoc.m.inst.c.e., 59, *Hope Street, Wrexham.*
1889. Jan. †Swan, Harold, 49, *Belleville Road, Wandsworth Common.*
1888. Dec. Swinburne, C. A., *Belgrave Mansions, Grosvenor Gardens, S.W.*
1889. Mar. Sykes, Matthew Carrington, l.r.c.p., m.r.c.s., d.p.h., *Barnsley.*
1888. Oct. †Tattersall, W., 90, *Arden Terrace, Accrington.*
1888. Oct. Taylor, Charles, m.r.c.s., l.s.a., 3, *Lorraine Road, Holloway, N.*
1889. Jan. Taylor, Wm. Fredk., m.d., m.r.c.s., l.s.a., *Brisbane, Queensland.*
1888. Oct. Teale, T. Pridgin, m.a., m.b., f.r.c.s., f.r.s., 38, *Cookridge Street, Leeds.*
1888. Oct. Thomas, Walter, assoc.m.inst.c.e., *Castleknowie, and Town Hall, Dover.*
1888. Oct. †Thomas, W. E. C., assoc.m.inst.c.e., *Eaglesbush, Neath.*
1889. Feb. Thompson, Thomas William, l.r.c.p., m.r.c.s., d.p.h., m.o.h., *Med. Inspr., Local Government Board, S.W.*
1890. June. †Thomson, Gilbert, 75, *Bath Street, Glasgow.*
1888. Oct. Thorneycroft, Lieut.-Col., *Tettenhall Towers, Wolverhampton.*
1888. Oct. Thornley, J. E., *Lyndon, Bickenhill, Birmingham.*
1890. Jan. Thresh, John Clough, m.b., b.s., d.sc., f.i.c., f.c.s., m.o.h., *Chelmsford.*

1889. Jan. THRING, RIGHT HON. LORD, K.C.B., F.R.G.S., 5, *Queen's Gate Gardens, S.W.*
1889. July. THURSFIELD, W. N., M.D., D.P.H., M.O.H., *Shrewsbury.*
1888. Dec. TITMAS, William, 34, *Grafton Street, W.C.*
1888. Oct. TRAVERS, William, M.D., F.R.C.S., 2, *Phillimore Gardens, W.*
1888. Dec. TREW, J. Fletcher, 12, *Clarence Street, Gloucester*, (22, *Broad Street, Bristol*).
1889. Nov. TRIPE, John W., M.D., M.R.C.S., M.O.H., F.R.MET.SOC., *Town Hall, Hackney.*
1888. Oct. TYNDALE, Walter Clifford, *Horse Guards, Whitehall, S.W.*, (*St. Stephen's Road, Ealing*).
1889. Mar. UNDERHILL, A. S., M.B., B.A., M.R.C.S., D.P.H., *Great Bridge, Tipton.*
1888. Dec. VACHER, Francis, F.R.C.S., M.O.H., 31, *Shrewsbury Road, Birkenhead.*
1888. Oct. VALON, William A., ASSOC.M.INST.C.E., *Connaught Mansions, Victoria Street, S.W.*, (*Ramsgate*).
1889. Nov. WADDY, Henry Edward, F.R.C.P., D.P.H., Camb., *Rhossili, Brunswick Road, Gloucester.*
1888. Oct. WAKEFIELD, Miss E. M., *Broughton, Longdon, Rugely.*
1888. Oct. WALLACE, William, 27A, *Old Bond Street, W.*
1890. Oct. †‡WALLIS, Arthur Gray, 46, *Talbot Street, Southport.*
1888. Oct. WALLIS, H. Sowerby, F.R.MET.SOC., 25, *Northwood Road, Highgate, N.*
1890. Apr. WALLIS, Isabel White, 49, *Clifton Hill, St. John's Wood, N.W.*
1890. Nov. WHEELER, Charles, 12, *Dovecote Villas, Wood Green.*
1889. Jan. WELCH, Henry, M.D., B.SC., D.P.H.EDIN., *Public Health Offices, Blackpool.*
1888. Nov. WELLS, SIR T. Spencer, BART., M.D., F.R.C.S., 3, *Upper Grosvenor Street, W.*
1888. Dec. †WHITCOMBE, Arthur, 48 & 50, *Howland Street, Fitzroy Square, W.*
1888. Oct. WHITE, William, F.S.A., F.R.I.B.A., 30*a*, *Wimpole Street, W.*
1889. Apr. WIGHTWICK, Fallon Percy, M.B., M.R.C.S., L.R.C.P., D.P.H., *St. John's, Horsleydown, S.E.*
1888. Oct. WILKINSON, W. B., *Northumberland Street, Newcastle-on-Tyne.*
1888. Oct. ‡WILKINSON, William, *Town Hall, Salford*, (20, *Aldren Street*).
1888. Oct. WILLIAMS, C. T., M.A., M.D., F.R.C.P., F.R. MET. SOC., 47, *Upper Brook Street, W.*
1889. Dec. WILLIAMS, William, M.A., M.B., D.P.H.OXON, M.R.C.S., L.S.A., *The Royal National Hospital, Ventnor.*
1889. Apr. WILLIS, George, L.F.P.S.G., M.O.H., *Clifton House, Baillieston, Glasgow.*
1888. Oct. †WILSON, J. B., *Kirklandhow, Arlecdon, Carnforth.*

1888. Oct. Withers, J. B. Mitchell, F.R.I.B.A., 73, *Surrey Street, Sheffield.*
1888. Oct. ‡†Witts, J. W., M.S.E., *Borough Engineer's Office, Leeds.*
1888. Oct. Wood, Jacob, *Highbury Park, N.*
1888. Nov. Wood, William, M.D., 99, *Harley Street, W.*
1889. Mar. Woodman, John, M.D., F.R.C.S., M.O.H., *Southernhay, Exeter.*
1888. Oct. Woodward, Edward Francis, 43, *Southwell Street, Bristol.*
1889. Jan. †Worth, John Edward, ASSOC.M.INST.C.E., F.R.MET.SOC., *Coombes Croft House, High Road, Tottenham.*
1888. Oct. Wyndham, Rev. Francis M., M.A., OXON, *St. Charles College, St. Charles Square, W.*
1889. May. Yarrow, George Eugene, M.D., M.O.H., *Oakley House, 317, City Road, E.C.*
1888. Oct. Yuill, W., ASSOC.M.INST.C.E., 3, *Fenchurch Avenue, E.C.*

ASSOCIATES (Assoc. San. Inst.)

‡ Marked thus have passed the Examination of the Institute for Inspectors of Nuisances.

1888. Oct. ‡Abrams, Henry, 5, *Westmoreland Road, Bromley, Kent.*
1889. Nov. ‡Adams, Albert E., *Local Board Offices, Wood Green.*
1888. Oct. ‡Adams, H. J., 25, *Coleford Road, Wandsworth.*
1888. Oct. Adams, Miss Rose (Ladies' Sanitary Association), 22, *Berners Street, Oxford Street, W.*
1888. Oct. Aitken, Charles, *Inglefield, Totland Bay, Isle of Wight.*
1889. Jan. ‡Allen, William Henry, 22, *Moira Street, Cardiff.*
1890. Nov. ‡Amor, Alfred, *Octagon Chambers, Nelson Street, Bath.*
1888. Oct. ‡Amor, Daniel C., 39, *Shirley Road, Freemantle, Southampton.*
1889. May. ‡Anderson, Tom, 32, *Harrington Street, Hampstead Road, N.W.*
1890. July. Annett, William Fenn, 5, *Church Street, Kensington.*
1889. Apr. Baker, William, 2, *Chetwynd Road, Lawrence Road, Southsea.*
1890. Mar. ‡Bailey, G., 159, *Parrock Street, Gravesend.*
1889. July. ‡Bailey, William, 74, *Wilmslow Road, Withington, Manchester.*
1889. June. ‡Bainton, John, *Scunthorpe, near Doncaster.*
1890. Feb. ‡Balster, Herbert, *Town Hall, Margate.*

1888. Oct. BAMLETT, Adam Carlisle, *Thirsk, Yorkshire.*
1889. Jan. ‡BARFOOT, James, 124, *Surrey Lane, Battersea.*
1888. Oct. ‡BARRON, John, 81, *Landor Road, Stockwell, S.W.*
1888. Oct. ‡BASCOMBE, H. C., 18, *Oxford Street, Totterdown, Bristol.*
1889. June. ‡BASSETT, William Joshua, 16, *Elizabeth Street, Eaton Square, S.W.*
1889. Feb. ‡BATEMAN, Charles G., *Durban, Natal.*
1890. Apr. ‡BAXTER, Frank E., 374, *Kennington Road, S.E.*
1888. Oct. ‡BAXTER, John, 374, *Kennington Road, S.E.*
1889. Jan. ‡BECK, William Coker, *Hastings.*
1889. Jan. ‡BEEL, Joseph Hicks, *The Alverstoke Local Board, Gosport.*
1889. June. ‡BIRCH, John Ernest William, 107, *Cobden Road, South Norwood, S.E.*
1890. May. ‡BIRD, William Fred., *Heath Villa, Radstock, Somerset.*
1890. July. ‡BISHOP, William F., 8, *Francis Place, Nine Tree Hill, Bristol.*
1888. Oct. ‡BLACK, Andrew E., 57, *Academy Street, Inverness.*
1888. Dec. BLAKE, E. T., M.D., 47, *Seymour Street, Hyde Park, W.*
1889. June. BLAND, William, 420, *Liverpool Road, Patricroft.*
1890. May. ‡BOND, George, 28, *Kew Bridge Road, Brentford.*
1890. Jan. ‡BOND, William Henry, *St. Giles Board of Works, Holborn, W.C.*
1888. Oct. ‡BOSTEL, G. Stanford, 18, *Duke Street, Brighton.*
1889. Jan. ‡BOVEY, William T., *Acton, W.*
1889. July. ‡BOWYER, Harry David, *Park Street, Slough.*
1888. Oct. ‡BOYCE, W., *Board of Works, High Street, Poplar, E.*
1888. Oct. BOYD, Richard Wade, 105, *New Bond Street, W.*
1888. Oct. BREEZE, John, *Poynton Lodge, Wellington, Salop.*
1888. Oct. BROAD, Clement B., *Stamford Brook Lodge, Ravenscourt Park, W.*
1890. Nov. ‡BROOK, John, *Albany Place, Stratford-on-Avon.*
1890. Nov. BROUGHTON, Thomas, *Garston, near Liverpool.*
1890. Nov. ‡BROWN, Edward, *Local Board Offices, Burgess Hill.*
1888. Oct. ‡BROWN, R. Railston, 1, *Blenheim Terrace, Bridlington Quay, Yorkshire.*
1888. Oct. ‡BROWN, W. E., 19, *Havelock Road, Hastings.*
1890. Jan. ‡BRYAN, George John, 4, *South Norwood Hill, S.E.*
1888. Oct. BUCHAN, W. Paton, *Fairyknowe, Cambuslang, Lanarkshire, N.B.*
1888. Oct. BUCKERIDGE, Walter, 5, *Alexander Street, Westbourne Park, W.*
1888. Oct. ‡BUGLER, W. J., *Alpha House, Putney.*
1888. Dec. BURN, Robert G. N., 14, *Newcastle Street, Farringdon Street, E.C.*
1888. Oct. BURROUGHS, S. M., *Snow Hill, E.C.*
1889. Oct. ‡BURSCOUGH, Frederick Peter, 18, *Spring Hill Terrace Oswaldtwistle, Lancashire.*
1889. May. ‡BUTLAND, R. J., *Town Hall, Brighton.*

1890. Apr. ‡BUTTERWORTH, Arthur, *Board of Works, Maxey Road, Plumstead.*
1889. Feb. ‡BUXTON, Anthony, *Carisbroke, Isle of Wight.*
1890. Feb. ‡CALLAWAY, Albert Henry, *Grosvenor Villa Evesham Place, Stratford-on-Avon.*
1888. Oct. ‡CATTEN, Joseph H., 32, *Exeter Street, Sloane Street, S.W.*
1889. Apr. ‡CHANEY, William H., 36, *Essex Street, Strand.*
1888. Oct. CHEEK, Philip, 4, *Wharves, Goods Station, King's Cross.*
1889. Feb. ‡CHRISTIE, David, 76, *Brunswick Avenue, Hull.*
1888. Oct. ‡CLARKSON, Joseph, 76, *Linaker Street, Southport.*
1889. Jan. ‡CLAYTON, Edward, *Mansfield, Notts.*
1890. June. ‡CLIFTON, Henry Chas., 50, *Porchester Road, Bayswater.*
1888. Oct. ‡COBHAM, C., *The Shrubbery, Gravesend.*
1888. Oct. COBHAM, G. R., 3, *Edwin Street, Gravesend.*
1890. Apr. ‡COCKBURN, Henry Mace, 27, *Claremont Road, West Kilburn, N.W.*
1890. Dec. ‡COOK, William Gough, 395, *Kennington Road, S.E.*
1889. Feb. ‡COOPER, William George, *Sanitary Inspector, Bournemouth.*
1890. Jan. ‡COPESTICK, George Christopher, 1, *Arboretum Square, Arboretum Street, Derby.*
1890. Jan. ‡CORBETT, Richard Lawrence, *Oakengates, Salop.*
1889. Jan. ‡CORDON, Robert Curtis, *Hillside Cottage, Duffield, Derby.*
1890. June. ‡CORRICK, Alfred.
1889. Mar. COTTLE, Arthur Thomas, *Selly Oak, Near Birmingham.*
1890. Mar. COURT, Thomas Henry, 103, *King's Road, Peckham,* (140, *Tanners Hill, Deptford*).
1889. Jan. ‡COWPER, Joseph, 22, *Talma Road, Brixton.*
1888. Oct. COWPER-COLES, Cowper Bickerton, 95, *Wigmore Street, W.*
1890. June. ‡CROCKER, Thomas William, *Vestry Hall, Pancras Road, N.W.*
1889. June. ‡CROCKWELL, George E., 14, *Church Street, Ilfracombe.*
1888. Oct. ‡CROGHAN, Thomas Andrew, 37, *Devonshire Gardens, Buxton.*
1890. Feb. ‡CROSSE, Hammond William, *St. Mary's Cottage, Putney.*
1890. Feb. ‡CROSSLEY, James, 30, *Shaftesbury Street, Eccles.*
1890. Jan. ‡CROWTHER, William Christopher, 51, *Hind Street, Stockton-on-Tees.*
1889. June. ‡DALTRY, John, *Sanitary Inspector, Wellington, Salop.*
1888. Oct. ‡DARLEY, George, 49, *St. Marks Street, Woodhouse, Leeds.*
1890. May. ‡DAVIES, T. Lane, 5, *Leopold Street, E.*
1890. June. ‡DAWSON, William, 6, *Brooklands Road, Birkenhead.*
1890. Mar. ‡DEAN, Samuel Saunders, *Hugglescote, Ashby-de-la-Zouch.*
1890. June. ‡DEE, Thomas George, 17, *Grosvenor Road, S.W.*
1888. Dec. DENSHAM, Charles A., 55, *Cochrane Street, St. John's Wood, N.W.*

1890. May. ‡Dick, William, *Kirknewton, Midlothian.*
1889. Apr. Douglas, The Hon. J., *Thursday Island, Torres Strait, Queensland.*
1890. Jan. Dover, John Henry, 13, *King Street, Kensington Square, W.*
1889. Jan. ‡Drake, W. Medley, *Kirkheaton, Huddersfield.*
1889. June. ‡Duck, Albert George, 211, *Tooley Street, Horsleydown, S.E.*
1890. Feb. ‡Dunbar, David, 41, *Summerfield Terrace, Aberdeen.*
1889. Feb. ‡Dyer, Samuel, 3, *Wellington Road, Bridlington Quay.*
1889. Jan. ‡Dyson, John Henry, *Park Terrace, Thornhill, near Dewsbury.*
1889. June. ‡Earlsley, William Oakley, 3, *Clephane Road, Canonbury, N.*
1889. Mar. ‡Easton, Charles Joseph, *Coombes Croft House, High Street, Tottenham.*
1890. Mar. ‡Edmonds, Henry James, 76, *St. John Street Road, E.C.*
1889. Jan. ‡Edmonds, William H., 105, *Great College Street, N.W.*
1890. Nov. Edwards, John, 16, *Gladstone Street, St. George's Road, S.E.*
1888. Oct. ‡Emptage, Daniel, *Dane Hill Sanitary Works, Margate.*
1888. Oct. ‡Evans, John Evan, 137, *Weston Street, Tooley Street, S.E.*
1890. May. ‡Evington, Charles William, 12, *Bridlington Street, Hull.*
1888. Oct. ‡Fairchild, Samuel C. G., 569, *Wandsworth Road, Clapham, S.W.*
1890. Mar. Finch, William, 44, *Mason Street, Kingston-upon-Hull.*
1889. Jan. ‡Fincher, John Gazeley, *Aldershot.*
1888. Oct. ‡Flower, T. J. Moss, *Liverpool Chambers, Corn Street, Bristol.*
1890. June. ‡Folland, John Percy, 22, *Liverpool Street, King's Cross.*
1888. Oct. ‡Fordham, Wm. Francis, *Hampton House, High Road, Kilburn.*
1890. May. ‡Forrester, William, *Headcorn, Ashford, Kent.*
1888. Oct. France, T. W. Chapman, 36, *Bristol Road, Edgbaston.*
1890. Jan. ‡Fulcher, George, *Stony Stratford.*
1889. May. Fulton, Peter, 72, *High Street, Camden Town, N.W.*
1888. Oct. Gairdner, Prof. W. T., M.D., LL.D., *The University, Glasgow.*
1888. Nov. ‡Gardner, C. T., 32, *Annandale Road, Chiswick.*
1888. Oct. ‡Garland, Wm., 12, *Higher Maudlin Street, Barnstaple.*
1888. Oct. Gass, John Bradshaw, A.R.I.B.A., 19, *Silverwell Street, Bolton.*
1889. June. ‡Gathercole, William Henry Joseph, *Engineer's Office, Guildhall, E.C.*
1890. May. ‡Gibbs, Arthur Gordon, 12, *Western Road, Littlehampton, Sussex.*

1890. Mar. ‡GIBSON, John, 5, *Stanghow Road, Skelton-in-Cleveland.*
1889. Mar. ‡GILBEART, John Joseph, 11 & 12, *Little Chester Street, Belgrave Square, W.*
1890. Jan. ‡GILLIES, Neill, *Lochgilphead, Argyllshire, N.B.*
1889. Apr. ‡GOLDS, Thomas William, *Vestry Hall, Paddington.*
1888. Oct. ‡GOODWYN, Arthur Ayde, 10, *Grosvenor Road, Richmond, Surrey.*
1889. Jan. ‡GRANT, Walter, 14, *Hyde Gardens, Eastbourne.*
1890. Nov. ‡GRAVES, Matthew Dodgson, $7\frac{1}{2}$, *College Street, York.*
1889. June. ‡GREENWELL, Allan, *Surveyor's Office, Frome.*
1888. Oct. GRIBBLE, Miss Sarah C., 11, *Willswood Park, Torquay.*
1890. June. GRINHAM, Philip Boys, *Tichborne Down, Alresford.*
1890. June. ‡GROOM, William Edwin, 117, *Wells Street, Camberwell.*
1888. Oct. ‡GUNN, Alexander, 123, *King Street, Aberdeen.*
1890. Jan. ‡HALL, George Berringer, F.G.S., 10, *Waldemar Avenue, Fulham Road.*
1890. May. ‡HALSTEAD, Robert, 301, *Queensgate, Burnley.*
1889. June. ‡HARRISON, George, *Keyham, Leicester.*
1890. Feb. ‡HARRISON, Henry, 5, *Beaconsfield Terrace, West Kensington.*
1888. Oct. ‡HARRISON, Wm. L., 7, *Dock Street, Hull.*
1888. Oct. ‡HART, W. S., 29, *Coley Hill, Reading.*
1890. Jan. ‡HAY, Alexander, *Barony Local Authority, Glasgow.*
1888. Oct. ‡HEAD, Robert H., 7, *Upper Baker Street, N.W.*
1888. Oct. HEARN, Walter, 72, *High Street, Huntingdon, and* 27, *Mecklenburgh Square, W.C.*
1888. Oct. ‡HEARNE, William, *Buenos Ayres.*
1889. June. ‡HELSDON, Horace, 14, *St. Edmunds Terrace, Primrose Hill, N.W.*
1890. Mar. ‡HILLS, Arthur Reginald, 24, *Harley Street, Bow, E.*
1888. Dec. ‡HOBBS, W. F., 36, *Melbourne Street, Stalybridge.*
1890. Mar. ‡HODGES, Albert, 57, *Hall Street, Blakenhall, Wolverhampton.*
1890. May. ‡HOLLAND, Percy, *Fairstead Cottage, Newmarket.*
1889. June. ‡HOLMES, William, 23, *Belgrave Rd., Keighley, Yorkshire.*
1889. June. ‡HOOPER, Thomas Rowland, *Redhill, Surrey.*
1890. Jan. ‡HOOPER, William, 4, *Lucas Road, St. John's Road, Penge, S.E.*
1888. Oct. HORNCASTLE, Henry, *Chobham, Woking Station, Surrey.*
1888. Oct. ‡HORROCKS, Joseph, 10, *Union Street, Southport.*
1889. Jan. ‡HOUGHTON, Robert Alfred, 5, *Springfield Road, Wimbledon.*
1890. Nov. ‡HUGHES, Edward J., 102, *Camden Street, Birkenhead.*
1890. Jan. ‡IMRIE, Henry William, 28, *Parry Place, Plumstead.*
1890. Feb. ‡INGRAM, William Jones, *Goldsworth Road, Woking.*
1890. Feb. JACOB, Oswald, *Sanitary Inspector, Feltham, Middlesex.*
1889. Feb. ‡JASPER, Robert Wevill, *Withersfield Road, Haverhill, Suffolk.*

1890. Jan. ‡Jellis, John, 188, *Uttoxeter Old Road, Derby.*
1889. July. ‡Jenner, Richard Messenger, *Parade Road, Sandgate.*
1890. May. ‡Johnson, John William, 785, *Commercial Road, Limehouse, E.*
1890. Nov. ‡Johnson, Joseph Edward, *Town Hall, Hull.*
1890. June. Jones, John, 40, *Sydney Street, Chelsea.*
1890. Nov. ‡Jones, Julius Morris Wilson, 27, *Mornington Road, Bow, E.*
1889. June. ‡Jones, William, *Cemlyn, Dolgelly, Merioneth.*
1890. Mar. ‡Jours, William, *Gateshead.*
1890. Dec. ‡Jury, H. A., *North-East Lodge, Chelsea Bridge, Grosvenor Road, Pimlico, S.W.*
1888. Oct. ‡Keal, J., *Southview Hill Road, Sutton, Surrey.*
1888. Oct. ‡Kemsley, Jesse, *Casilla del 'Correo, Buenos Ayres.*
1888. Oct. ‡Kiell, John, 103, *High Street, Barnstaple.*
1889. Feb. ‡King, Frederick William, *Heybridge, Maldon, Essex.*
1888. Oct. Kite, Charles, 31, *Barronsmere Road, East Finchley.*
1890. May. ‡Knight, Robert, junr., *Dunfermline, Fife.*
1889. Feb. ‡Knight, William Henry, 10, *Bury Road, Noel Park, N.*
1889. June. ‡Lander, James, 111, *St. John's Road, Upper Holloway.*
1888. Oct. ‡Lapworth, J., *Vestry Hall, Bethnal Green, E.*
1889. Nov. ‡Laurie, John, *Albany Villas, Weston Road, Gloucester.*
1889. July. ‡Layland, William Thomas, *Grimstone, King's Lynn.*
1889. Jan. ‡Lear, James Walter, 114, *Culford Road, De Beauvoir Town, N.*
1889. Mar. ‡Lee, James, 25, *Trafford Street, Rochdale.*
1888. Oct. ‡Legg, S. C., 117, *Powerscroft Road, Lower Clapton, N.E.*
1888. Dec. ‡Lennox-Clarke, A.
1889. Jan. ‡Lewis, Arthur, *Isham, Wellingborough.*
1888. Oct. ‡Lightfoot, Thomas, 3, *Trevor Square, Knightsbridge.*
1890. May. ‡Lightfoot, William Charles, 20, *High Road, Knightsbridge.*
1890. Jan. ‡Lilly, William Gent, 5, *Whitcomb Street, W.C.*
1890. Nov. ‡Little, William, 51, *Trafalgar Street, Carlisle.*
1890. Feb. ‡Littleton, Louis, 45, *Roundhill Street, Bradford.*
1890. Mar. ‡Lock, G. H., 64, *Richards Terrace, Roath, Cardiff.*
1889. Jan. ‡Lukes, Arthur Henry, *Town Hall, Gravesend.*
1890. Nov. ‡Lund, Clifton, 2, *Arbour Street, Southport.*
1888. Oct. ‡Lund, Jeremiah, *St. James's Vestry, Piccadilly.*
1888. Oct. ‡McDonald, A. L., 37, *George Street, Gipsy Hill, S.E.*
1888. Oct. MacIntosh, James, 38, *Langham Street, W.*
1889. July. Mackay, George Archibald D., Inspector of Cleansing, *Edinburgh.*
1889. Apr. Mackay, James John, 186, *Kensal Road, W.*
1890. Feb. ‡Maclennan, John, *Carnock House, Carnock, Dunfermline.*
1890. June. ‡Maguire, James, *Sanitary Inspector, Huddersfield.*
1890. May. ‡Malcolm, Alfred, *Clayton, near Manchester.*
1889. July. ‡Marland, George, 88, *Huddersfield Road, Oldham.*

1889. May. Marson, A, J., 390, *San Martin, Buenos Ayres.*
1890. Apr. Mason, Jonathan, 1, *Grove Terrace, Grove Road, Leytonstone.*
1888. Oct. ‡Mathias, H. D., 43, *Weldon Street, Walton, Liverpool.*
1889. Feb. ‡May, William H., *Vestry Hall, Hampstead.*
1888. Dec. Merrill, John, *Albany Road, Sheffield.*
1889. Jan. ‡Millard, William David, 1, *Elswick Villas, Ramsgate.*
1890. Oct. ‡Milner, W., 18, *St. Paul's Road, Preston.*
1888. Oct. ‡Minty, Samuel, *The Triangle, Bournemouth.*
1890. Feb. Mitchell, Edward, 25, *St. Saviour's Road, Croydon.*
1888. Oct. Molineux, Walter Frank Yate, *Shifnal, Salop.*
1890. June. ‡Moody, Henry Fred, 26, *Cavendish Street, Gt. Grimsby.*
1889. Jan. ‡Morgan, Francis Robert, 43, *Upper Baker Street, N.W.*
1889. July. ‡Nettleton, Charles William, 16, *Winchester Terrace, Westminster, S.W.*
1888. Dec. Norris, Joseph, *Sunningdale, Surrey.*
1890. Mar. ‡Norrish, John Thomas, 9, *Cuthbert Road, Brighton.*
1890. May. ‡Nurcombe, Benj., 9, *Kingswood Road, Clapham Park.*
1890. June. ‡Nutley, Charles Vernon, 13, *Dalling Road, Hammersmith.*
1889. Feb. ‡Oldfield, David, *Bloemfontein, Orange Free States, South Africa.*
1890. Oct. Oliver, G., 14, *St. John's Road, Waterloo, Liverpool.*
1889. Jan. Oliver, John Penry, 8, *Grove Terrace, Highgate Rd., N.*
1889. Mar. ‡Ollett, John Henry, *Sanitary Inspector, Eastbourne.*
1889. Nov. Ord, James, 11, *Portman Street, W.*, (41, *Upper George Street, W.*).
1888. Oct. Palliser, Christopher, *Northallerton.*
1890. Jan. ‡Palmer, Henry Arthur, *P. H. Office, N. Church Street, Sheffield.*
1890. May. ‡Parham, John, junr., 113, *Malham Road, Forest Hill, S.E.*
1889. Oct. ‡Parsons, William, *St. Luke's Vestry Hall, City Road, E.C.*
1889. Jan. ‡Patrick, Alfred Ross, *South View, East St., Farnham.*
1890. May. ‡Pattison, William Phillip, 8, *Addison St., Sunderland.*
1888. Oct. Pearce, George Edward, *Dartford, Kent.*
1888. Oct. ‡Pearson, John, *Sanitary Inspector, Grace Hill, Folkestone.*
1890. June. ‡Perman, Edward, 3, *Railway St., Newport, Monmouth.*
1888. Nov. ‡Perry, Arthur, 45, *Townshend Road, St. John's Wood.*
1889. June. ‡Perry, Walter Harold, 10, *Berkeley Avenue, Bishopston, Bristol.*
1889. Feb. ‡Pettit, George Mackness, *Frederick Villa, Padua Road, Penge, S.E.*
1890. May. ‡Phillips, Henry, 2, *Pickard Street, City Road, E.C.*
1890. Jan. Poole, James, 2, *Trafalgar Place, Kensington.*
1888. Oct. ‡Potter, Ben, *Heathfield House, Broadway, Ealing.*

1889. Jan. ‡POTTER, Thomas Wickford, *Estate Works, Thoresby Park, Ollerton, Notts.*
1889. Jan. ‡POULSON, Frederick Thomas, 11, *Hobury Street, Chelsea.*
1889. Feb. POWELL, David Henry William, *Surveyor, Pontypool.*
1889. Jan. ‡PRATT, Joseph, 12, *Kirkdale, Sydenham.*
1889. Mar. ‡PRESS, William James, *Rose Villa, Abingdon Street, Burnham, Somerset.*
1888. Oct. PROGER, John L., 11, *Cwrtiy-vie Road, Penarth, Cardiff.*
1888. Oct. ‡RAINS, Joseph, *Kettering.*
1890. Nov. RANDLE, William Thomas, *Head Inspector, Karachi, India.*
1888. Oct. ‡REAVELL, George, Jun., *Alnwick, Northumberland.*
1888. Oct. ‡RICHARDS, Daniel, 3, *Spencer Street, Park Road, Battersea*
1890. Apr. ‡ROBERTSON, John Shirras, 4, *Belmont Street, Aberdeen.*
1890. Jan. ‡ROBINSON, John, 79, *Lavender Road, Clapham Junction.*
1888. Oct. ‡ROGERS, Richard, *Maes Helew, Carnarvon.*
1890. May. ‡RUSCOE, Ernest Henry, 6, *Great Castle Street, Regent Street, W.*
1889. July. ‡RYDER, Albert Thomas, *Dudley Villa, Foster Hill Road, Bedford.*
1889. Jan. ‡SADLEIR, Richard J., 6, *Cornford Grove, Balham.*
1890. Dec. ‡SAISE, Alfred John, *Fishponds, Stapleton, Bristol.*
1888. Oct. ‡SALTER, Thomas, 2, *King's Road, St. Leonards-on-Sea.*
1890. May. ‡SAUNDERS, Percy, 29, *The Drive, Thornton Heath.*
1890. June. ‡SAVORY, Charles, 6, *Holford Place, W.C.*
1888. Oct. SEDGWICK, Sydney, 10, *Mortimer Street, Cavendish Square, W.*
1888. Oct. SEVENOAKS, William, *Acre House, Windsor.*
1888. Oct. ‡SHADRAKE, W. A., 8, *Hind Street, Stainsby Road, Poplar, E.*
1890. Feb. ‡SHAW, Peter, *Selham Cottage, Selham, Petworth, Sussex.*
1889. Jan. ‡SHELDON, W. E., *The Croft, Wantage, Berks.*
1888. Oct. ‡SHORE, Ambrose J., 68, *Adys Road, East Dulwich.*
1889. Apr. ‡SHORT, James Allen, 4, *Vronhill Street, Liverpool.*
1889. Apr. ‡SIDWELL, Henry Thomas, *Elm Cottage, Herne Bay, Kent.*
1888. Oct. ‡SIMMONS, Nimrod, *Glendale, Clifton, Bristol.*
1890. Jan. ‡SIMPSON, John Thomas, 28, *King's Road, Peckham.*
1890. May. ‡SIMPSON, John, 30, *Belmont Street, Aberdeen.*
1890. Feb. SLATER, Robert, *Headingley Hill, Leeds.*
1890. Apr. ‡SLEATH, Frederick Edward, 60, *Great Prescott Street, Whitechapel.*
1888. Oct. ‡SMITH, George Allen, *Vestry Hall, Hampstead.*
1890. June. ‡SMITH, Joseph Sidney, 73, *Elm Park, Brixton Hill, S.W.*
1890. Nov. SMITH, Sydney, *Dorset Cottage, Hastings Road, Bexhill.*
1890. June. ‡SMITH, W. H., 60, *Alma Vale Road, Clifton, Bristol.*
1888. Oct. ‡SOPER, Henry Charles, 108, *Park Street, Camden Town, N.W.*

1888. Oct. ‡Sortwell, W., 14, *Retreat Place, Paragon Road, Hackney, E.*
1888. Oct. Southport, The Mayor and Corporation of.
1888. Oct. ‡Stanley, A. W., 12, *Midland Street, Hull.*
1888. Oct. ‡Steers, George, 21, *Brereton Road, Bedford.*
1888. Oct. ‡Stevenson, John, *Surveyor's Office, East Molesey, Surrey.*
1890. Apr. Stratford, George Wilkin, 126, *Vauxhall Street, Upper Kennington Lane.*
1889. Apr. ‡Strutt, Thomas Frederick, 5, *Tavistock Street, Covent Garden, W.C.*
1890. Feb. ‡Sutherland, Walter, 8, *Voelas Street, Liverpool.*
1890. Nov. ‡Suttle, Alfred, *Manor Square, Otley.*
1890. Nov. ‡Sydenham, Sydney, 37, *Broad Street, Bath.*
1889. Jan. ‡Tait, James, *Roslyn Place, Dean Street, Kilmarnock.*
1889. Jan. ‡Tate, William, 77, *Glengall Road, Kilburn.*
1890. Nov. ‡Taylor, Henry Thomas, 10, *Higham Street, Everton, Liverpool.*
1889. Jan. ‡Taylor, James, 17, *Oxford Street, Hereford.*
1890. May. ‡Taylor, James, 10, *Mount Pleasant, Waterloo, Liverpool.*
1889. Jan. ‡Temple, William Herbert, *Scarborough.*
1890. May. ‡Thomas, George, *Royal Engineers' Office, Preston.*
1888. Oct. ‡Thomas, Thomas, 4, *Chandos Road, Redland, Bristol.*
1888. Oct. ‡Thomas, W. K., 16, *Berkeley Place, Clifton, Bristol.*
1890. Oct. Thompson, Bernard H., *Royal Engineers' Office, Windsor.*
1890. Nov. ‡Thornley, William Frederick, 5, *Napier Villas, Napier Road, Southsea.*
1889. Feb. ‡Thorpe, James, *Hobson House, Tytherington, Macclesfield.*
1890. June. ‡Tomkins, Alfred, 62, *Church Street, Camberwell.*
1890. Nov. ‡Trigg, Henry John, *South Hayling, Hants.*
1888. Oct. Tuckey, George F., 47, *Milk Street, Bristol.*
1889. Jan. Tunstall-Clarke, William, 18, *Holly Avenue, Newcastle-on-Tyne.*
1890. June. ‡Turner, Alfred, 33, *Wordsworth Road, Penge, S.E.*
1890. Dec. Veasey, Thomas Frederick, assoc.m.inst.c.e., 2, *Clarence Terrace, Richmond, Surrey.*
1890. June. ‡Walker, Francis, 18, *Mardall Street, Shepherd's Bush, W.*
1888. Oct. Wallace, Miss J., 6, *Hyde Park Gardens.*
1889. Nov. Wallas, Irwin Clarke, 37, *Torbay Road, Willesden Lane, N.W.*
1890. Nov. Wallis, Thomas Wilkinson, *Surveyor, Louth, Lincoln.*
1890. May. ‡Wansbrough, Cecil Shartman. *Arlington Villa, Barrow-in-Furness.*
1888. Nov. Watts, George Nelson, 147, *High St., Notting Hill, W.*
1890. Jan. ‡Watts, Gerald, 7, *Earl Street, Cambridge.*
1890. Feb. ‡Watts, William Frederick, *Bitterne, Southampton.*

1888. Oct. ‡Webb, James A., 1, *Stanley Villas, St. Marks Road, Hanwell.*
1890. Nov. ‡Weeks, Alfred James, 140, *Lavender Hill, Clapham Common.*
1888. Oct. ‡Wells, G. F., 37, *Prospect Street, Hull.*
1890. Dec. Wheeler, John, M.D., 35, *Oxford Road, Kilburn, N.W.*
1888. Oct. ‡Wilkinson, W., *Ford Street, Derby.*
1890. Nov. ‡Willbond, George Baines, *Guildhall, Nottingham.*
1889. Mar. ‡Willey, Andrew William, 14, *Watney Street, Commercial Road, E.*
1889. Mar. ‡Wilson, Charles Turle, 37, *Burney Street, Greenwich, S.E.*
1889. June. ‡Wilson, John, *Town Hall, Kensington.*
1889. July. ‡Wilson, William, 3, *Orsborne Terrace, South Shields.*
1888. Oct. ‡Winser, F. Sawyer, 52, *Buckingham Palace Road, S.W.*
1889. Apr. ‡Winter, Edward, 19, *King's Gardens, W. Brighton.*
1889. Jan. ‡Wood, Peter, 177, *Ashmore Road, Paddington.*
1889. July. Woodcock, Henry, 16, *Steelhouse Lane, Birmingham.*
1889. Mar. ‡Woonton, James, 64, *Anthony Street, E.*
1890. May. ‡Wrack, Thomas Philip, 15, *Great Alie Street, Whitechapel.*
1889. Jan. ‡Wright, John, Junr., 3, *Surbiton Park Terrace, Kingston-on-Thames.*

GENERAL INDEX.

THE DETAILS OF THE EXPERIMENTS REFERRED TO IN DR. SEATON'S REPORT ARE AS FOLLOWS:—

The "St. Bede Disinfectant" was now ln solution, one block being dissolved in one quart of water.

1.—The "killing power," i.e., the power to kill microbes, was tested on the following microbes: (A) bacillus anthracis without spores, (B) spores of bacillus anthracis, (C) the comma-bacillus found in Asiatic cholera, (D) the bacillus found in human typhoid fever.

Of normal cultivations in broth of these several microbes, about three drops were added to about three cubic centimetres of the disinfectant solution, well mixed, and after the lapse of five minutes, one to two drops of the mixture were added to tubes containing about 10 c.c. normal sterile beef broth; for control similar normal sterile beef broth was inoculated with a mere trace of the same culture fluids used for the above experiments. All broth tubes were placed in the incubator at 37° C., while all the control tubes showed already after twenty-four hours' copious typical growth of the several microbes, the others were perfectly clear and remained so afterwards. It follows from these experiments that five minutes' exposure of bacillus anthracis, of spores of bacillus anthracis, of the choleraic bacilli, and of the typhoid fever bacilli to the "St. Bede Disinfectant" solution is sufficient to kill these microbes.

2.—An important and extremely severe test of the killing power of the "St. Bede Disinfectant" solution was made in the following experiments:—

To normal human fœcal matter in thick solution, previously sterilised and contained in test tubes, was added a certain quantity of normal culture fluid of the choleraic bacilli and of the typhoid fever bacilli respectively, about one-seventh of the culture fluid being added to six-sevenths of the fœcal solution. After mixing well the disinfectant was added to each of the fœcal mixtures in equal proportions, so that each of the test tubes contained ½ of the fœcal matter plus culture fluid, and ½ of the disinfectant. After five minutes a number of test tubes containing sterile beef broth, as in the former series, were inoculated with a drop or two from these fœcal mixture tubes, then placed in the incubator and kept at 37° C., but no growth appeared in them and the fluids remained sterile. At the same time that the above experiments were made, control broth tubes were inoculated with a trace of the fœcal solution after the addition to them of the culture fluids, but before the addition of the disinfectant, these control tubes were also placed in the incubator and kept at 37° C., they all showed abundant normal growth after twenty-four hours of the choleraic bacilli and of the typhoid bacilli respectively.

(Signed) E. KLEIN, M.D., F.R.S.,
Professor of Bacteriology at the College of State Medicine, London.

LABORATORY AND ASSAY OFFICE,
75, THE SIDE, NEWCASTLE-UPON-TYNE,
July 6th, 1889.

I hereby certify that I have analysed a sample of the "St. Bede Disinfectant," manufactured by Messrs. The St. Bede Chemical Company (Limited), Newcastle-upon-Tyne, and that I find it contains as follows: ..

Per-Chloride of Mercury	4·01	per cent.
Free Sulphuric Acid	4·10	,,
Sulphate of Soda	87·25	,,
Sulphate of Lime	1·30	,,
Oxide of Iron, &c.	0·27	,,
Chloride of Sodium	0·21	,,
Insoluble Siliceous Matter	0·24	,,
Thymol, Eucalyptus, Indigo, and Water	2·62	,,
	100·00	

The principal active ingredient of this disinfectant is Per-Chloride of Mercury (corrosive sublimate) which is known to be the most certain and powerful destroyer of disease germs. When the "St. Bede Disinfectant" is dissolved according to the instructions given it forms a solution of the strength and character recommended by Dr. Buchanan, the Medical Officer of the Local Government Board, as being effective as a disinfectant. It is prepared and packed in a form which makes it convenient and easy to be used.

(Signed) JOHN PATTINSON, F.I.C., F.C.S.,
Public Analyst for Newcastle-upon-Tyne.

SPECIAL TERMS FOR LARGE QUANTITIES.

MANUFACTURED ONLY BY

The St. Bede Chemical Company, Limited,

NEWCASTLE-UPON-TYNE.